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ANALYSIS OF SOLDIER BORNE SENSOR (SBS) EMPLOYMENT AND TRAINING PROGRAM

by

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New technology improves combat power. The military continually adopts new technology; however, the holistic support and maintenance of that technology may be a lesser consideration. In this case, Program Executive Office (PEO) Soldier provided the Soldier Borne Sensor (SBS), which is a hand-launched, remotely controlled drone that offers improved situational awareness to the Soldiers closest to the fight. This study provides insight into how Soldiers were trained to use the system, and how they used it in novel ways.

Specifically, this study examined the differences in use between home-station training and operational deployment. Using both surveys and semi-structured interviews, the research team found that the new equipment training (NET) was effective, yet opportunities for improvement exist. Further, and as one might expect, the creativity of the American Soldier in employing new equipment cannot be underestimated. This study documents a few instances of that creativity and suggests that future training should be updated with lessons learned down-range.

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LIST OF ACRONYMS AND ABBREVIATIONS

1st SFAB	1st Security Forces Assistance Brigade
ACTA	Applied Cognitive Task Analysis
ADDIE	Analysis, Design, Development, Implementation, and Evaluation
AWFC	Army Warfighting Challenges
AGL	above ground level
ALM	Army Learning Model
AMPS	Aviation Mission Planning System
ASA AL&T	Assistant Secretary of the Army for Acquisitions, Logistics, and Technology
BCT	Brigade Combat Team
BoI	basis of issue
CIT	Critical Incident Technique
COTS	commercial off-the-shelf
CTA	Cognitive Task Analysis
DA	Department of the Army
DOTMLPF-P	doctrine, organization, training, material, leadership, and education, personnel, facilities, and policy
EO	electro-optical
EUD	End-User Device
FMF	Follow Me Function
FoV	field of view
FUE	First Unit Equipped
GPS	Global Positioning System
IR	infrared
IRB	Institutional Review Board
LoS	line of sight
MANCOE	United States Army Maneuver Center of Excellence
MBL	Maneuver Battle Lab

METT-TC	mission, enemy, troop, terrain, time, and civilian considerations
NET	New Equipment Training
NSN	National Stock Number
PEO	Program Executive Office
PM	Program Manager
PoI	Program of Instruction
QCA	Qualitative Content Analysis
QRG	Quick Reference Guide
REF	Rapid Equipping Force
SBS	Soldier Borne Sensor
SME	Subject Matter Expert
SOP	Standard Operating Procedure
SUAS	small unmanned aerial system
TM	technical manual
TR	training regulation
T.R.	training reference
TRADOC	United States Army Training and Doctrine Command
TTP	tactics, techniques, and procedures
UAS	unmanned aerial system
USB	universal serial bus

EXECUTIVE SUMMARY

The Soldier Borne Sensor (SBS) is a small unmanned aerial reconnaissance platform used at the platoon level and below that enables soldiers to gain and maintain observation from a secure position. In 2019, PEO Soldier fielded the SBS to 3rd BDE 82nd ABN, prior to an operational deployment. Since the SBS was fielded, four attempts have been made to collect user feedback; however, they have not provided PEO Soldier the required data to validate the employment and training of the system. The purpose of this research is to collect data on SBS employment methods and inform the program office if users are using the SBS system in unanticipated ways.

The methodology used to collect and analyze the data was a modified version of the Applied Cognitive Task Analysis (ACTA) framework. The methodology contained four steps: analyze existing material, collect SBS user feedback, organize and validate feedback, and data analysis.

A total of 25 participants, varying in military occupational specialties (MOS), were selected to participate in this study. Seven participants were interviewed, and the remaining 18 participants completed surveys. Qualtrics, a web-based survey tool, was used to develop the surveys. NVivo, a qualitative analysis software, was used to categorize the data using a code structure.

The final code structure was comprised of five functional areas: training, employment, hinders to training and employment, documentation, and future configuration. The functional areas were further decomposed into categories, sub-categories, and codes to describe and analyze the collected data. During the analysis, the team identified seven differences among training, employment, and documentation. The SBS system employment from training differences were the follow-me function, night training, and mounted operations. The SBS system's training from documentation identified differences with the follow-me function and no standardized unit reference for training. Lastly, the SBS system's documentation and employment identified a difference with the follow-me function.

The results of this project indicate that the SBS system training programs and employment methods are evolving as the number of training events and operational deployments with the system increase. To further facilitate the evolution of SBS employment, the team recommends further analysis into the airspace control procedures of U.S. Army installations. Additionally, the team recommends a follow-on study on employment methods to capitalize on the population increase of SBS users caused by the current SBS fielding efforts.

I. INTRODUCTION

The Soldier Borne Sensor (SBS) is a small unmanned aerial reconnaissance platform used at the platoon level and below that enables soldiers to gain and maintain observation from a secure position. The system was acquired in 2017 to satisfy capability requirements supporting three of the U.S. Army Training and Doctrine Command (TRADOC) Army warfighting challenges (AFWC): develop situational understanding, conduct air-ground reconnaissance, and conduct joint combined arms maneuver (Program Executive Office [PEO] Soldier 2017). The first unit equipped (FUE) with the SBS system was the 3rd Brigade Combat Team, 82nd Airborne Division (3/82), in May 2019. Since the initial fielding, PEO Soldier fielded the system to 14 additional units.

3/82 received the SBS system prior to a combat deployment, which facilitated data collection on the system in an operational environment. The operational environment is defined as a non-training environment in which external factors influence how users employ a system (Department of the Army [DA] 2018b). Four surveys have been developed and administered to SBS users to collect user feedback. The first survey was developed by the Maneuver Battle Lab (MBL) to gather data on altitude restrictions. The second survey was developed by the Department of the Army's G8 office (HQDA G8) to determine future funding allocations to the SBS program. The third and fourth surveys were modified versions of the HQDA G8's survey. The third and fourth surveys were developed by 3/82's unmanned aerial system (UAS) operations officer to collect more detailed information about the SBS's performance during 3/82's deployment.

While the surveys provided useful feedback, they did not assess the alignment of the formal training program with actual employment or if the system was used in unanticipated ways. As the number of surveys increased, SBS user participation decreased, and their feedback was less comprehensive. According to 3/82's Brigade Unmanned Aerial Systems (UAS) Operations Officer, Chief Warrant Officer 4 Adam Rickert, respondent fatigue among SBS operators was the cause for the decrease in survey participation (email to authors, May 11, 2020). Lastly, 3/82 was surveyed during re-deployment; therefore, the

timing of the survey diminished the depth and quality of responses due to competing priorities.

Currently, PEO Soldier and the capstone team only possess the results of surveys from 3/82 and 1st Security Forces Assistance Brigade (1st SFAB). Furthermore, PEO Soldier does not possess the required feedback or studies examining the SBS training program or how users employ the system in the diverse array of operational environments demanded by various missions. The data collection and analysis mechanism required for PEO Soldier to modify the existing system, if necessary, or shape future increments does not exist. As additional units with the SBS return from combat deployments, it is critical to collect operators' knowledge and experiences for PEO Soldier.

A. PROBLEM STATEMENT

PEO Soldier lacks the required data to validate the employment and training of the current SBS system. Further data collection is needed to determine if unanticipated uses of the SBS system have emerged and, as a result, if the training program requires modification.

B. RESEARCH QUESTIONS

The SBS capstone project aims to answer one primary research question: what differences exist between the way users employ the SBS system, the training they receive, and the system's training documents?

Three sub-research questions assist in soliciting detailed information to support answering the primary research question:

- What training do the soldiers who employ the SBS system receive?
- How do soldiers employ the SBS system in operational settings?
- How do soldiers utilize the SBS system's documentation?

C. STAKEHOLDERS

The SBS capstone project has three stakeholders: the program manager, SBS operators, and the contractor. Table 1 provides an overview of the three stakeholders, the stakeholder classification, needs, and goals for the research.

Table 1. Stakeholder Analysis

Stakeholder	Category	Need	Goal
Program Manager	Beneficial stakeholder	Operational employment feedback	Improve current and shape future iterations of the SBS
SBS Operator	Beneficial stakeholder	Improved training program	Improved task proficiency while using the SBS system
Contractor	Charitable beneficiary	Operational employment feedback	Remain the primary contractor

The primary stakeholder is the program manager within PEO Soldier; the program office's goal is to gain SBS users' feedback on their operational employment of the system. The program office is a beneficial stakeholder, which means it provides input enabling the research and, in return, directly benefit from the project's deliverables to fulfill their needs (Crawley, Cameron, and Selva 2016): an analysis of user feedback to improve the current SBS system and shape future iterations.

The SBS operators are likewise beneficial stakeholders because their feedback is required input to attain the project's objectives; however, the research provides different benefits to SBS operators—namely, facilitating improvements to the training program. All units trained and equipped with the SBS system are included in the operator stakeholder category. The SBS has been fielded to units through two organizations. PEO Soldier fielded seven units, and the Rapid Equipping Force (REF) fielded four units. Table 2 describes the following information regarding the SBS: fielding timeline, receiving unit, home station location, fielding organization, and deployment location.

Table 2. U.S. Army Units with the SBS System

Date	Unit	Location	Fielding Organization	Deployment w/ SBS System
Sep 2018	2 BCT, 4th ID	Afghanistan	REF	Afghanistan
Apr 2019	7th SFG	Eglin AFB, FL	REF	Unknown
May 2019	3rd BCT, 82nd ABN	Fort Bragg, NC	PEO Soldier	Afghanistan
Jun 2019	3rd SFG	Fort Bragg, NC	REF	Unknown
Aug 2019	1st BCT, 25th ID	Fort Wainwright, AK	PEO Soldier	Iraq
Sep 2019	1st SFAB	Fort Benning, GA	PEO Soldier	None
Oct 2019	2nd B.N., 75th RGR	Hunter Army Airfield, GA	REF	Unknown
Dec 2019	1st BCT, 10th MTN	Fort Drum, NY	PEO Soldier	Iraq
Feb 2020	1st BCT, 82nd ABN	Kuwait	PEO Soldier	Iraq
Feb 2020	2nd BCT, 82nd ABN	Fort Bragg, NC	PEO Soldier	Iraq
Jul 2020	1st BCT, 2nd ID	Joint Base Lewis-McChord, WA	PEO Soldier	None
Aug 2020	2nd BCT, 25th ID	Hawaii	PEO Soldier	None
Aug 2020	3rd BCT, 25th ID	Hawaii	PEO Soldier	None
Aug 2020	4th BCT, 25th ID	Joint Base Elmendorf-Richardson, AK	PEO Soldier	None
Sep 2020	3rd BCT, 10th MTN	Fort Polk, LA	PEO Soldier	None
Sep 2020	7th SFG	Eglin AFB, FL	PEO Soldier	None
Oct 2020	2nd Cavalry Regiment	Germany	PEO Soldier	None
Oct 2020	173rd BCT	Germany	PEO Soldier	None
Oct 2020	2nd BCT, 2nd ID	Joint Base Lewis-McChord, WA	PEO Soldier	None

The project's third stakeholder is the contractor or system manufacturer. The contractor is a charitable beneficiary because it does not provide support to the capstone team but indirectly benefits from the outcomes of the research in the design and development of future development products (Crawley, Cameron, and Selva 2016). There was no correspondence or interaction that occurred with the contractor during the research, which confirmed its classification as a charitable beneficiary.

D. PROJECT OVERVIEW

The purpose of this research project is to provide useful narratives to assist the program office in improving the SBS system and the corresponding formalized training program. The four objectives of the research project are:

- Gain narrative data from SBS users and expand the body of knowledge for the program office.
- Conduct a qualitative analysis of the narrative data elicited from SBS users.
- Identify any inconsistencies between the way SBS users employ the system and the training they received.
- Provide recommendations for possible training modifications or user employment methods to shape future versions of the SBS system.

The project captures and analyzes the SBS user narrative through semi-structured interviews and surveys with SBS users to inform the program office if users are employing the SBS system in unanticipated ways. The information garnered through these research efforts informs PEO Soldier on methods to better align training documents with these modified uses of the SBS. The scope of the capstone project is the training users receive and their methods of SBS employment in an operational environment. The intent is to identify alternative applications of the SBS system to satisfy operational needs and compare it against the operator's understanding of the training program. Three steps were vital in obtaining the required information: reviewing prior research, surveys, and relevant

literature; identifying critical assumptions; and developing a suitable methodology to answer the research questions.

The literature review (Chapter II) examines prior studies, surveys, and research methods to derive the methodology. Although the collection of prior work and user feedback is small, it codifies the requirement to analyze the SBS system's training and employment. To date, we believe that there is only one study on the SBS system occurred in 2019 as a Naval Postgraduate School capstone project. That project compared the physical display size of the SBS system's end-user device (EUD) to a commercial off-the-shelf (COTS) phone display to determine if the smaller display degraded situational awareness. It determined that the SBS operator's situational awareness did not diminish with the smaller display (Bush et al. 2019). The previous project recommended further analysis of the training and employment of the SBS system to optimize the performance of the SBS system. In addition to the prior capstone study, Chapter II examines the results of the four prior surveys, which assessed system performance; and PEO Soldiers' new equipment training (NET) end-of-course critiques, which assessed the quality of the training course. The remainder of the literature review examines misalignments between equipment employment and the training program due to SBS user innovation as well as the most appropriate research methods.

Six critical assumptions emerged from the literature review to bounding the research project. Furthermore, these assumptions shaped the methodology for eliciting information from SBS operators. Table 3 describes the six assumptions, elaborated further in Chapter II.

Table 3. List of Assumptions

Assumption	Justification
Respondent fatigue	Multiple requests for information to elicit knowledge occurred before the SBS capstone study.
A semi-structured interview is preferred	Surveys are the only method used previously, which does not provide the rich narrative required by PEO Soldier.
Current survey objectives	The surveys do not elicit the information needed to achieve the capstone research objective.
Existing survey method	The current method (surveys) and the timing of the survey contributed to respondent fatigue.
Training program gaps	User innovation will lead to gaps in the training program.
Innovation caused by unknown requirements	Users understand their needs best and create innovative ways to obtain solutions to their needs (Korreck 2018; von Hippel 1986).

Two limitations further bounded the research. The first limitation was access to SBS users due to the severe acute respiratory syndrome coronavirus 2 (COVID-19) pandemic's travel restrictions and the mandatory quarantine periods associated with authorized travel. The travel restrictions added two 14-day quarantine periods to routine official travel, severely hindering the capstone team's ability to conduct in-person interviews. The second limitation was aligning the research timeline with SBS users' availability, which was restricted by their higher headquarters' training calendar and mission timelines. Synchronizing the research timeline with unit availability limited the number of SBS operators sampled for the research.

The literature review, assumptions, and limitations played a pivotal role in the development and refinement of the capstone's methodology (Chapter III). Based on these considerations, the research team determined that the applied cognitive task analysis (ACTA) is the ideal framework to answer the research questions and accomplish the objective. Semi-structured interviews and surveys are the most appropriate methods of eliciting the required data from SBS operators. To ascertain any misalignments between the operator use and training, the research team conducted interviews and surveys with participants to document a narrative on SBS system employment and the training program. The qualitative and quantitative analysis of the interview and survey data identified themes

from SBS operators on the system employment and training from the data collection process. The data is analyzed, and the results are presented in Chapter IV. Chapter V describes the recommendations and summarizes how the goals of the research were achieved.

II. LITERATURE REVIEW

The purpose of the literature review is to gain understanding of existing information and applicable training material for the Soldier Borne Sensor (SBS) system capstone project. As a new program of record in the U.S. Army, there are limited data about user feedback on the SBS system. The literature review consists of the two prior SBS system surveys completed by operators, approved SBS system training, SBS user feedback on the employment of the system, and applicable task analysis methods and analyses.

A. PRIOR SBS SURVEYS

A review of existing SBS surveys guided the research team in developing a collection method to explore the evolution of the SBS training curriculum and to extract detailed accounts of SBS employment. Reviewing previous data elicitation efforts avoided overlapping and repetitive data collection in this research project. The results of four iterations of SBS surveys were made available to the capstone team. These surveys solicited SBS operator feedback about the performance of the system. Survey 1 was developed and administered by the Maneuver Battle Lab (MBL). Survey 2 was developed by the U.S. Army Deputy Chief of Staff, G8 (HQDA G8) and administered to 3rd BCT, 82nd ABN (3/82) and the 1st Security Forces Assistance Brigade (SFAB). The UAS Operations Officer for 3/82 expanded Survey 2 to solicit additional information in Surveys 3 and 4. Table 4 shows a timeline of the surveys, the issuing agency, and the units surveyed. Appendix A through Appendix D provide copies of the surveys shown in Table 4.

Table 4. Survey Timeline

Survey Timeline			
Survey	**Surveyor**	**Unit**	**Date**
Survey 1	MBL	3/82 operators	Summer 2019
Survey 2	HQDA G8	1st SFAB operators	Spring 2020
Survey 3	3/82 UAS Operations Officer	3/82 operators	Spring 2020
Survey 4	3/82 UAS Operations Officer	3/82 supervisors	Spring 2020

The MBL enables force modernization by recommending changes to Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, Facilities, and Policy (DOTMLPF-P) (Army.mil). The MBL observed the SBS new equipment training (NET) to determine if altitude restriction imposed by Flight Regulations, AR 95-1, allowed the SBS to effectively perform its intended functions (Montoyo 2019). The most recent AR 95-1 dated 22 March 2018, states "The SBS will operate at or below 100 ft. above ground level (AGL)" (DA 2018a, 66). Survey 1, developed by MBL in the summer of 2019, attempted to capture 3/82 SBS operators' observations on the performance of the system at varying altitudes and flight conditions to determine if the current altitude restriction needed to be increased (Montoyo). Twenty-six SBS operators from 3/82 completed the NET; however, the program office only has 12 completed copies of Survey 1 in its records. The 12 surveys were provided to the capstone team for review. Survey 1 provided data on environmental effects on the SBS; however, it was not designed to elicit data on SBS employment tactics or the training program. The resulting recommendations made by MBL based on Survey 1 were not made available to the capstone team.

In Survey 2, the HQDA G8 elicited data from 1st SFAB and 3/82 to potentially make recommendations on the future of the Army acquisition's SBS program. A role of HQDA G8 is to coordinate with the Assistant Secretary of the Army for Acquisitions, Logistics, and Technology (ASA (AL&T)) to provide recommendations concerning acquisition programs. Survey 2 solicited SBS operators' opinions of the system and asked for recommendations on changes to make to the system to improve its performance or

capabilities. The capstone team received 23 of 1st SFAB's completed copies of Survey 2; the original quantity distributed was not known. As with Survey 1, Survey 2 did not elicit the type of data the capstone team was looking for, such as SBS employment tactics, instances of user innovation, and information about SBS training material. The recommendations made by HQDA G8 based on Survey 2 were not made available to the capstone team, nor was the team aware if the suggestions recorded have been or will be implemented by the program office.

Surveys 3 and 4 were developed by 3/82's UAS operations officer, CW4 Adam Rickert. Based on his UAS experience, CW4 Rickert expanded on Survey 2 to develop Surveys 3 and 4 to more comprehensively capture the capabilities and limitations of the SBS. Survey 3 was distributed to SBS operators; it asked questions about the physical design of the SBS controller and frequency of SBS component failure. Survey 4 was distributed to personnel in leadership positions (e.g., commander, platoon sergeant, etc.), and asked questions about SBS planning, employment tactics, and reasons for not employing the system. Both Surveys 3 and 4 asked questions about frequency of SBS use, limitations of the system, and attempted to capture operational narratives. Surveys 3 and 4 provided data on the tactical employment of the SBS and elicited data on 3/82's SBS planning considerations. Additionally, the surveys provided more information on the limitations and capabilities of the SBS and why the use of the SBS was not consistent across 3/82. Surveys 3 and 4 captured useful information on SBS employment tactics and captured few instances of user innovation; however, the sample size was small and did not accurately reflect the SBS user population across the U.S. Army. Surveys 3 and 4 only elicited information from a single brigade combat team (BCT) after the execution of one deployment in a single operating environment. The capstone team required a more diverse population to account for additional variables that influence the employment method of the SBS, such as mission, unit type (e.g., dismounted, armored, motorized), and operating environment (e.g., mountainous terrain, dessert, jungle). Additionally, Surveys 3 and 4 did not specifically elicit data on SBS training; however, some surveys captured responses that identified the lack of training on the SBS as a deterrent for using the system. An objective of the capstone team is to compare the SBS training to the methods of employment in an

operational environment. The responses of Surveys 3 and 4 confirmed the need to review the training curriculum and the source used to develop the training.

B. TRAINING

The capstone team reviewed previous and current versions of SBS operator manuals, training publications, and qualification training courses. The examination provided insight into the evolution of the SBS's training programs during the transition from two commercial companies to the U.S. Army. Prox Dynamics was the original manufacturer of the SBS. In 2016, FLIR bought Prox Dynamics and all proprietary information associated with the SBS. The U.S. Army acquired the SBS from FLIR in 2017 and began fielding the system in 2019. Figure 1 shows the sequence of manuals and training references leading up to the current operator's manual and program of instruction (PoI) used by the program office to train SBS operators.

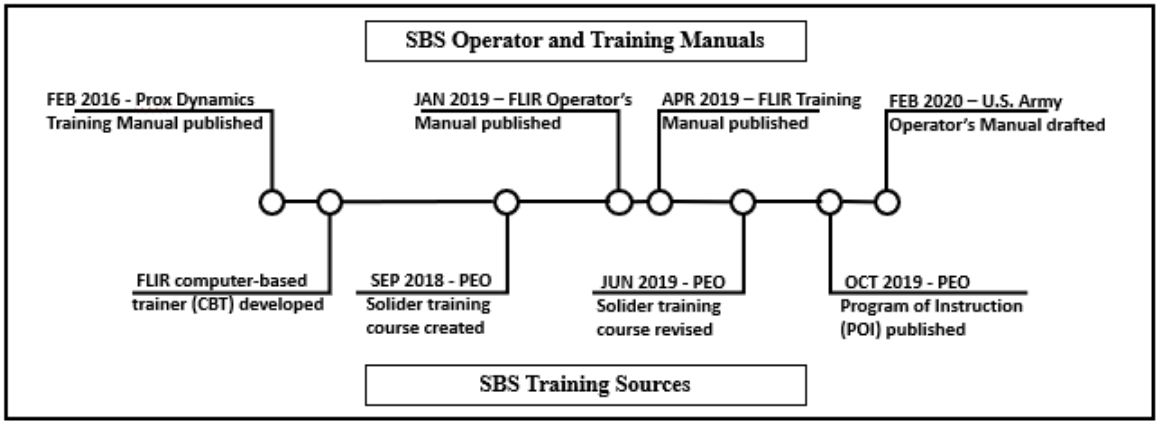

Figure 1. Timeline of SBS Manuals and Training References

1. SBS Manuals

Training programs for the SBS are currently codified in the Technical Manual 11-1550-261-10 and the qualification course instructed by the program office (DA 2020). As previously stated, Table 5 describes the sequence of the SBS's operator's and training manuals. The proceeding sub-sections provide further insight into the significant differences as the program evolved.

Table 5. SBS Operator and Training Publications

Operator and Training Publications			
Pub #	**Publication Type**	**Publisher**	**Date**
1	Training Manual	Prox Dynamics	23 February 2016
2	Operator's Manual	FLIR	02 January 2019
3	Training Manual	FLIR	09 April 2019
4	Technical and Operator's Manual (draft)	U.S. Army	15 February 2020

Prox Dynamics' training manual, Publication 1, was published in February 2016 to accompany their Prox Dynamics' operator's manual. The team received a copy of the training manual, but could not obtain a copy of the Prox Dynamics operator's manual. Publication 1 provided information regarding training course structure, to include teacher to student ratio and equipment and facilities required to conduct SBS training (Prox 2016). The one-to-four teacher-to-student ratio and the one-kilometer training area suggested by Publication 1 are currently used by the program office to train SBS operators. Publication 1 included a section dedicated to an instructor course, a course that trains SBS operators to become SBS instructors. This section was omitted from the FLIR training manual, Publication 3, for reasons not disclosed to the capstone team.

FLIR's operator's manual, Publication 2, was published in January 2019 (FLIR 2019a). Because the capstone team was unable to obtain the Prox Dynamics operator's manual, a comparison could not be made with Publication 2. Publication 2 described the

characteristics of the SBS, basic operations, operational modes, and maintenance procedures. The SBS specifications contained in Publication 2 were used in conjunction with the information provided by Publication 3 to develop FLIR's training course.

FLIR's training manual, Publication 3, is the current training manual used by the company to train SBS operators (FLIR 2019b). The capstone team was not able to determine if earlier versions of Publication 3 existed between FLIR's acquisition of Prox Dynamics in 2016 and the release of this current version in April 2019. Publication 3 provided recent manufacturer changes to the SBS course structure. A notable change between Publications 1 and 3 was the recommendation to increase the duration of the SBS basic course from 8 to 13 training hours. Publication 3 added a module focused on training the GPS-Denied function of the SBS, a module which was not found in Publication 1. The GPS-Denied function is a navigation mode that enables the system to use its cameras to navigate instead of the satellite-based GPS.

A review of Publication 2 allowed the capstone team to trace the origin of the Army's technical and operator's manual, Publication 4, which was drafted by PEO Soldier in February 2020 (DA 2020). At the time this report was written, the official release date of Publication 4 had not been determined. A review of Publication 4 was necessary to determine if any elements of the manufacturer's operator's manual, Publication 2, were omitted or altered. Publication 4 omitted information concerning data management. PEO Soldier's lead SBS trainer revealed that the program office was asked to delete this section due to cyber-security restrictions (Jaraan Little, personal communication, July 27, 2020).

2. Training References

The publications described above contain the body of knowledge for training programs. Upon acquiring the SBS, PEO Soldier assumed responsibility for ensuring existing training material followed the Army's training structure (PEO Solider 2017). Training Regulation (TR) 350-70 provides guidance for structuring training courses. TR 350-70 outlines the Army Learning Model (ALM), provides a framework for designing courses and should be used in conjunction with the Analysis, Design, Development,

Implementation, and Evaluation (ADDIE) method. ADDIE is a process designed to develop and improve learning products (DA 2017).

The ADDIE Model is a cyclical process that comprises analysis, design, development, implementation, and analysis. This instructional design method aims at identifying learning requirements, developing learning objectives to meet defined requirements, finding alternative learning methods, and integrating technology into the learning process (DA 2017). According to TR 350–70, the evaluation of the training material conducted during ADDIE focuses on developing metrics to assess the effectiveness of the learning material and the presentation of material to users. Since the acquisition of the SBS, the program office has trained SBS operators using two variants of the training course outlined by a Program of Instruction (PoI). Additionally, a computer-based training software is available for purchase through FLIR. Table 6 shows the different training references which have contributed to the development of the current SBS lesson plan found in Training Reference (T.R.) 3.

Table 6. Development of SBS Training References

Training References			
T.R. #	**Reference Type**	**Publisher**	**Date**
T.R. 1	Computer-Based Training (CBT)	FLIR	Unknown
T.R. 2	Course presentation	PEO Soldier	September 2018
T.R. 3	Course Presentation	PEO Soldier	May-July 2019
T.R. 4	Program of Instruction (POI)	PEO Soldier	October 2019

SBS operators use the computer-based Training Reference 1 (T.R. 1) to gain and maintain proficiency with the system. It was developed by FLIR using the information outlined in both Publications 2 and 3. T.R. 1 is the source reference for both T.R. 2 and 3, the variants of PEO Soldiers' PoI. Since the Army developed their own training material, as prescribed in TR 350–70, the Army no longer requires the use of T.R. 1.

As previously mentioned, it was the responsibility of PEO Soldier to restructure the course once the SBS became an Army program of record (PEO Soldier, 2017). T.R. 2 was developed by PEO Soldier in 2018 to train 3rd BCT, 82nd ABN (3/82), the first unit

equipped (FUE) under the Army SBS program. PEO Soldier used the ALM principles to restructure the SBS course and the ADDIE model to develop and modify SBS training. Although the structure of T.R. 2 was modified from T.R. 1, the content of T.R. 2 closely resembled that of T.R. 1.

Training Reference 3 (T.R. 3) was developed by PEO Soldier in July 2019 after 3/82's SBS NET PEO Soldier shortened the duration of the course for administrative reasons. T.R. 3 removed the requirement for students to operate the SBS at night to practice using the SBS' thermal camera. Because the thermal function can also be operated during the day, PEO Soldier did not see the need to conduct the training at night. Additionally, T.R. 3 removed the data management procedure to stream the SBS video feed to a dedicated laptop. Removing the data management procedure eliminated the risk of SBS users violating Army Network Enterprise protocols. The most significant addition to T.R. 3 was the SBS simulator. The SBS simulator is a software program installed on a high-performance laptop with an identical SBS hand controller plugged into the universal serial bus (USB) port. The simulator allowed the NET team to train users in the classroom prior to hands-on training.

T.R. 4, the program of instruction (PoI), was derived from T.R. 2 and 3. A PoI is a document used by the Army to publish course structure. It provides information on course duration, methods of instruction and delivery techniques. The PoI was not required prior to the SBS becoming an official Army program.

C. EMPLOYMENT

Despite the ADDIE-influenced PoI, PEO Solider has collected accounts of users employing the system in unanticipated ways. These accounts of user innovation have led to changes in the SBS functional design. As the functional design evolved, SBS training required updating to incorporate the changes made. This capstone attempted to capture any differences in employment tactics used by units who have received different versions of SBS training. An example of user innovation leading to changes in the SBS functional design was captured by the Rapid Equipping Force (REF). A member of the REF informed the research team that earlier versions of the SBS did not possess a GPS-Denied function

(SFC Rubenstein, personal communication, June 19, 2020). The unit being trained attempted to operate the system indoors, which prompted the manufacturer, FLIR, to add a GPS-Denied function to subsequent models of the SBS.

A more recent example of innovation was recounted by PEO Soldier. The SBS does not have a function to command the SBS to automatically follow the operator; however, there is a function that commands the SBS fly to a default way point. The default way point can be set as the operator; the activation of this default waypoint can thus serve as a "follow" command (Jaraan Little, personal communication, July 27, 2020).

D. TASK ANALYSIS

Task analysis is employed frequently in research to elicit information from subject matter experts (SMEs) for the purpose of understanding how tasks are performed in a system (Adams, Rogers, and Fisk, 2012). Cognitive Task Analysis (CTA) provides an approach to this research method that focuses on cognitive activities rather than physical or behavioral activities. A CTA is defined as "the extension of traditional task analysis techniques to yield information about the knowledge, thought processes, and goal structures that underline observable task performance. It captures information about both overt, observable behavior, and the covert cognitive functions behind it [to] form an integrated whole" (Chipman, Schraagen, and Shalin 2000, 3). The goal of conducting a CTA is to capture the knowledge to enhance or build future capabilities. The two standard techniques used in CTA are: eliciting user knowledge through observations or interviews and process tracing through observing the use of the system by users (Cooke 1994). By capturing user performance, a structured framework emerges to fill in knowledge gaps about how operators are using the system.

The CTA has four subordinate steps and organizational flows: collect current knowledge, identify themes, conduct analysis with verification from SMEs, and format the results (Clark et al. 2008). The CTA provides a method to obtain knowledge from SBS operators to enhance the capabilities of the warfighter. Due to the number of subordinate steps involved, the full CTA is potentially overkill and not compatible with the timeline and skill level of the research team. Cognitive Task Analysis (CTA) requires researchers

to have skills in cognition and a significant amount of time to collect data. However, understanding the CTA's data analysis processes is still valuable information and later described in this chapter. Applied Cognitive Task Analysis (ACTA) offers a streamlined approach for novice researchers in the field of cognitive psychology. Figure 2 describes an ACTA approach and the numerous tools available for each step.

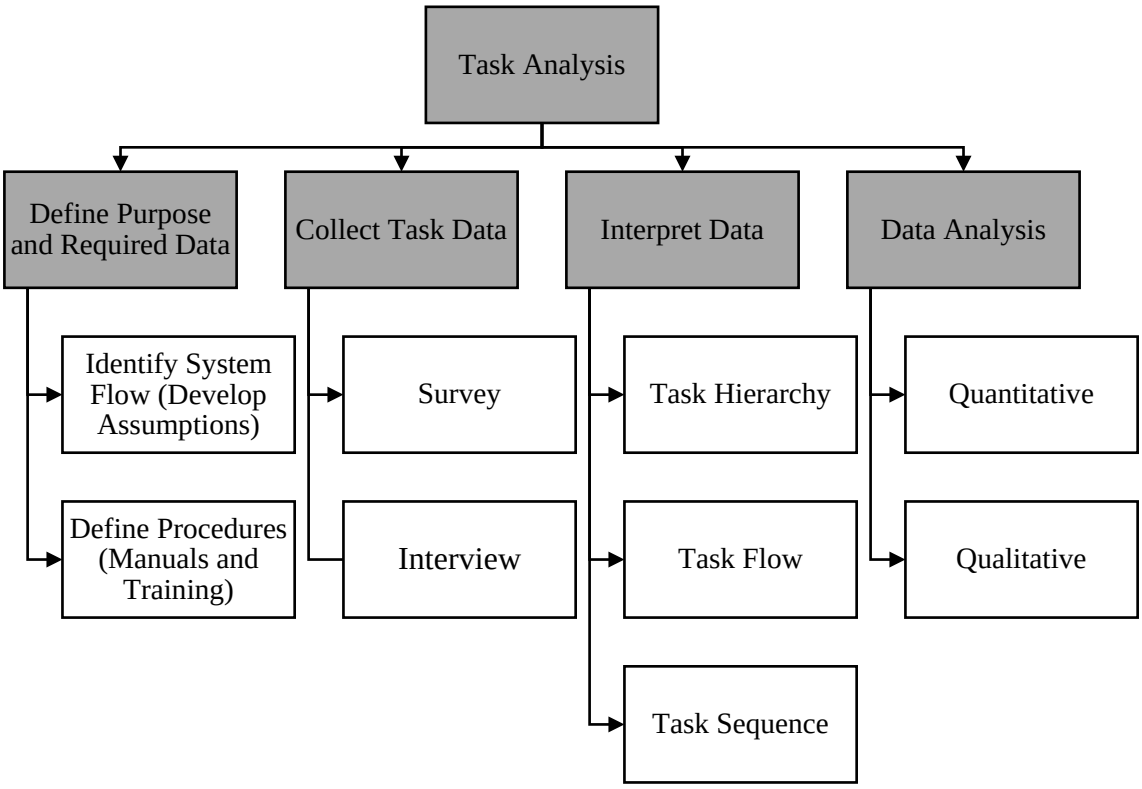

Figure 2. ACTA Decomposition Chart. Adapted from Clark et al. (2008).

The structure of an ACTA mirrors the traditional CTA; however, knowledge elicitation occurs much more quickly. ACTA encourages the use of interviews and surveys to elicit information from operators; it is highly effective when used for analyzing complex tasks involving technical systems (Militello and Hutton 1998). Other ACTA tools to elicit information include the task diagram, knowledge audit, and simulation interviews. Probing questions and video interviews occur throughout the collection process to gain insight into the operators' ability to effectively use the system.

The first step in an ACTA involves a thorough analysis of the system. The goal is to determine if a problem exists and how to organize the current training material to help solve the problem (Lee et al. 2017). The analysis of the training material aids researchers in making assumptions on the utilization of the system or improving the training through cognitive or physical analysis. Hierarchical, information, sequence, timing, and environment are five collection methods to help organize the data (Lee et al.). For example, the hierarchical collection method arranges information from interviews and surveys in an organized manner for further data analysis (Lee et al.). These collection tools align with the goals of SBS research, such as identifying gaps in the system or training to improve future versions of the SBS.

The second step in the ACTA is the collection of task data from the SME using five methods to elicit information. The methods are observation, retrospective or prospective verbal protocol analysis, interviews, surveys, and automatic data recording (Lee et al. 2017). Each technique provides an advantage and disadvantage to the researcher. For example, retrospective or prospective verbal protocol analysis offer the best opportunity to eliminate bias from SMEs' observations during knowledge elicitation. However, retrospective and prospective analyses are the most time-consuming methods. SMEs complete standard scenarios in the form of a simulated training exercise in either an operational or controlled environment (simulation) followed by a structured interview (Clark et al. 2008).

The third step of ACTA requires researchers to organize the collected data. The three most common methods of organizing data are hierarchy, flow, and sequence (Lee et al. 2017). These methods of organization are tailorable to any research project based on the data. An activity diagram is an output of a hierarchy organizational flow and expresses the dynamics of the system and how SMEs utilize the system, represented in behaviors over time (Delligatti 2014). It is essential to note in an ACTA that the SMEs must validate the tasks and flows of behavior by the researchers before the creation of any output to ensure accuracy (Clark et al. 2008). Once the organization of data occurs, the final step of analyzing the data can take place.

The final step of an ACTA uses qualitative and quantitative techniques to extrapolate findings from data. Qualitative techniques code the data using multiple methods that identify themes common to the system (Militello and Hutton 1998). For example, qualitative methods provide insight into how users train and employ the system. These themes can then help to identify recommendations or potential gaps in capabilities. Quantitative techniques use descriptive or inferential statistical methods (Clark et al. 2008). Using a descriptive quantitative technique along with qualitative aids researchers in understand the sample population (e.g., mean age or education level).

E. DATA ELICITATION

The primary benefit of a semi-structured interview method is in its combination of the strengths of structured and unstructured interviews. It uses predetermined questions that allow for clarifying, follow-up questions—known as probing questions (Noonan 2013). Noonan demonstrates how these probing questions allow for further explanation. However, this type of interview is more challenging to perform as it is generally used by experienced researchers.

The design of the interview process and structure allow for a deeper understanding of user knowledge elicitation. The first step is to consider the sample size, type of the population to sample, and how to select the population. The criterion for choosing eligible users is probabilistic sampling (Hua 2016; Oishi 2003; Roulston 2010). However, probabilistic sampling is typically not the preferred method in qualitative research with a small sample size. In this case, the amount of SBS operators is a small subset of the population. Hua argues that non-probability sampling methods such as "convenience sampling," "snowball sampling," and "quota sampling" are cheaper and more convenient in qualitative research (Hua 2016, 195). An example of convenience sampling is when researchers choose users due to their accessibility. Snowball sampling occurs when the original users nominate or recruit other users. This type of sampling is useful when the researcher is unaware of other members of the same group. Quota sampling is derived from subgrouping to make a comparison of two different groups (Hua 2016).

The structure is essential to successful information collection. Noonan (2013) lists four factors that contribute to successfully eliciting a rich narrative experience from interviewees: tonal inflection, criteria selection, record keeping, and body language. Each factor either hinders or assists in the extraction of valuable information. Qualitative questions should be well-defined and neutral; therefore, tonal inflections should be neutral and easy to understand. Body language provides insight into how a user feels about an answer. Interviewers should avoid leaning forward and refrain from facial expressions to avoid influencing the interviewee. Researchers must practice these interview techniques in order to prevent adverse impacts on narrative collection. In addition, researchers must decide on the type of record keeping. Examples include video recording, audio recording, electronically captured responses, and note taking methods (Rabionet 2009).

In a survey, the questions are delivered to the user either through physical paper copies or through electronic means (Hua 2016). The lack of face-to-face interaction with the interviewer creates some anonymity. This anonymity allows for respondents to be more open and honest in their answers. There are many ways to utilize the survey method. Numerical rating scales typically occur at the end of course surveys and use scales, often ranging from one to five. Likert scales are similar to numerical ratings but use descriptive ratings such as agree and disagree. An additional method is a Sematic Differential Scale, which uses a graduated response on a continuum. Survey methodology is modular in knowledge elicitation and allows the incorporation of other forms of data collection.

When developing questions for surveys and interviews, researchers have to consider factors that will affect answers, such as response order bias. Oishi (2003) discusses three response order biases that should be planned for and mitigated in the course of qualitative research: memory error, response set, and primacy/recency effect. In memory error, Oishi explains, the user momentarily forgets the most accurate answer and instead chooses the answer that first comes to mind. A way to mitigate this is through a memory jumpstart by describing relevant events that happened and allowing the user time to think through the answer. Further probing and follow-on interviews can also help the user to remember the event accurately. A one-answer response-order bias is particular to surveys and questionnaires. The respondent either picks the first or last answer on a list when

presented with a lengthy list of answers or ratings (Oishi 2003). This can also occur when a user is fatigued or does not comprehend the question. Therefore, researchers should consider the length of their surveys to prevent this type of response bias. The benefit of a conversational tone is twofold: first, it creates a safe environment that is conducive to rich narratives; and second, it helps to prevent some of the previously discussed response order biases. The third response order bias is a response where the user will agree on rating scales when presented (Oishi 2003). While Oishi does not present why these response bias can occur, it is clear that the structure, careful organization of listed questions, types of research methods, and length and number of interviews/surveys is instrumental in soliciting the accurate and descriptive responses of users.

F. DATA ANALYSIS

Data analysis is the culmination of task analysis and well-structured data elicitation to uncover underlying concepts, themes, and disparities. Data analysis provides useful insights to improve a system based on user feedback. While the typical analysis process presents conclusions after sampling the user population, a more appropriate data analysis method is the concept of theoretical sampling, where "concepts are derived from data during analysis and questions about those concepts to drive the next round of data collection" (Corbin and Strauss 2008, 143). Theoretical sampling is the feedback loop following initial data analysis to further explore themes and concepts in subsequent iterations of data elicitation. The section highlights the importance of structuring and coding qualitative data, analysis techniques, and legitimizing results to provide sensible recommendations.

Structuring and coding qualitative data is the first stage in the qualitative data analysis processes, acting as a form of inquiry itself. Coding allows researchers to organize large amounts of data at the abstract level that leads to the identification of themes (Corbin and Strauss 2008). Consolidating data from multiple collection methods is complex and is further complicated by semi-structured interviews, given the unbounded scope of users' responses. Numerous qualitative data analysis methods exist. However, three established qualitative data analysis methods most accurately correlate with the research questions at

hand: Qualitative Content Analysis (QCA), Cognitive Task Analysis (CTA), and the Critical Incident Technique (CIT). Of note, the CTA is the same task analysis method previously described; however, the CTA's data analysis, a subordinate step, provides utility in understanding the procedures for qualitative data analysis. Furthermore, the QCA, CTA, and CIT research methods provide insight into the importance of coding and different techniques before higher-level analysis.

Qualitative Content Analysis is the broadest method of raw data structure and organization. Developing meaning in a QCA starts by correlating all the material within interview transcripts into similar categories. Based on the nature of the responses, the categories are defined at the coding frame. The coding frame provides a tailorable approach to group similar responses from interview transcripts. By focusing on material relevant to the overall research question, the amount of material is reduced and becomes easier to connect themes (Schreier 2014). QCA data analysis allows researchers to consolidate like frames. Frame construction is an iterative process, segmenting the collected data to build, evaluate, modify, and validate its consistency. A primary point of concern with this technique is oversimplifying the frame and unintentionally placing responses in the same category without exploring the minor contextual differences in responses.

The final two research methods for structuring and coding concepts center around a Cognitive Task Analysis and the Critical Incident Technique. Both emphasize the importance of building data structures through coding but become more restrictive in the manner used to analyze qualitative data. A CTA aims to produce a description of task knowledge. In a CTA, elicited information is "coded to summarize, categorize, and/or synthesize collected data" (Clark et al. 2008, 7). A cognitive demands table is a useful tool to code results and provides researchers the ability to assign data to several categories including—but not limited to —task, cognitive skill, challenge, or outcome (Militello and Hutton 1998).

Critical Incident Technique is a similar research method that is well-defined but focuses on coding material elicited from subjects about specific critical incidents. According to the developer of the CIT, John Flanagan, an incident is "any observable human activity that is sufficiently complete in itself to permit inferences and predictions to

be made about the person performing the act" (1954, 327). He further defines critical as "a situation where the purpose or intent of the act seems fairly clear to the observer and where its consequences are sufficiently definite to leave little doubt concerning its effects" (327). As the name suggests, the technique focuses on critical incidents to concentrate on essential themes versus collecting subjective opinions. Eliminating subjective responses is crucial. A limitation is the CIT's focus on analyzing purely objective statements and all the relevant facts surrounding critical incidents. The CIT's data analysis process requires clustering data by a descriptive theme, which "may be grouped according to broader categories depending upon the research questions" (Redmann, Lambrecht, and Stitt-Ghodes 2000, 145). Despite the modified applications, the examined research methods illuminate the necessity to conduct initial analysis through comprehensive coding.

The transformation of raw interview transcripts into refined data is the prelude to a holistic evaluation of the knowledge elicited. qualitative content analysis, cognitive task analysis, and critical incident technique methods of analysis all code data as the precursor to a higher level of analysis, as described above. The overall objective of these data analysis methodologies is to aggregate like data to form themes, which identify relationships and add to the body of knowledge (Crandall 2006). Common themes emerge by examining refined data. Inconsistencies and gaps in information are equally important to shape subsequent data collection efforts or discuss in the findings. Categorized data is the necessary foundation for more substantial validation through qualitative analysis, quantitative analysis, or a combination of the taxonomies.

Well-structured and adequately coded data generates opportunities for quantitative analysis to add depth or a new perspective to research. Using a QCA, CTA, or CIT qualitative analysis method enables the identification of common questions, issues, and themes as the as data is elicited through interviews and surveys (Crandall 2006). The higher-level analysis takes a holistic assessment of all data to discover meaning and explore the convergence and different themes to identify new relationships across the array of interview transcripts and surveys. There is not a defined standard to represent the results and findings of qualitative data analysis. Narrative formats, chronologies, process diagrams, data tables, and hierarchies are a few examples of formats to present the findings

of a qualitative research project. The presentation of qualitative analysis is flexible and dependent on the research questions. For example, Flanagan (1954) describes a 1953 study conducted by Vasilas et al., who interviewed over 1,700 pilots and recommended improvements to training, equipment design, and operating procedures in a narrative format. A second example is a side-by-side comparison identifying discrepancies between an approved, published checklist and commonly used procedures described by users during interviews.

By using descriptive statistics, researchers represent and describe the sample population where the data originated. Questions with structured responses, such as a Likert scale, can be represented by describing the central tendency and variability of responses across the range of respondents. Additionally, calculating frequency metrics illustrates the most common responses. The application of the Chi-square analysis allows "the identification of theme clusters that occurred more frequently than expected by chance" (Redmann, Lambrecht, and Stitt-Gohdes 2012, 146).

Documenting the analysis procedures is just as important as the coding because it aids in legitimizing and validating the quality of research. A subject's opinions, interpretations, and ability to recall past events are the basis of survey and interview data; furthermore, the data are often subjective. Documenting methodological steps and decisions creates an audit trail connecting findings to raw data (Crandall 2006) and is an essential pillar of credibility. Three commonalities emerged across all the reviewed literature to provide credibility to the findings and a framework for future analysis or review: discussing the sample size, consistency in coding, and avoiding a single researcher's assessment to provide a more comprehensive analysis.

The credibility to qualitative research lies in the researcher team's ability to describe the data collection, analysis, and findings, as opposed to the credibility being exclusively dependent on the size of the population sampled. Many qualitative research guidelines instruct "continuing interviews until a point of saturation is reached" (Weller et al. 2018, 2). The point of saturation is where "no additional new concepts are found" (Schreier 2014, 179). However, the goal of qualitative research is to elicit the most important themes that aid in building the body of knowledge (Weller et al. 2018). The size

of the data collection process is not as crucial in providing validity when compared to outlining the collection and analysis process, conclusions, and potential limitations.

Two case studies illuminate the higher relative importance of describing the data analysis process as compared to the sample size itself. A qualitative concept elicitation study evaluated 544 interviews across 26 studies, and the findings concluded that "researchers can reasonably expect to elicit nearly 85% of all concepts after ten interviews, more than 90% of concepts after 15 interviews, and more than 95% after 20 interviews" (Turner-Bowker et al. 2018, 841). Furthermore, data collection methods using semi-structured or unstructured interviews explore more expansive topics by freely allowing themes and concepts to emerge from a smaller sample size. A 2018 study analyzed 28 qualitative studies with a total 1,147 interviews, and a key result was that less structured interview questions resulted in 95% of the most prominent issues arising during the first ten interviews (Weller et al. 2018). The population and sample size of users is essential to discuss in the analysis; however, it is more important to describe the method utilized and repeat collection and analysis as necessary.

The coding structure is paramount to the analysis process, and consistently applying a frame across all data provides the research validity and legitimacy. The QCA process shows the concept of consistency through three frame requirements: Unidimensional, Mutually Exclusive, and Exhaustiveness (Schreier 2014). Primary frame requirements are unidimensional, ensuring they only cover one topic, such as actual employment, designed employment, and training. Secondly, raw data are mutually exclusive and partitioned in only one subcategory per primary topic. The final requirement is exhaustiveness, ensuring the inclusion of all information within the frame.

Finally, multiple individuals reviewing and agreeing on the frame incorporates divergent perspectives and experiences. Multiple reviewers serve as a pseudo-Delphi method to establish a framework before beginning the investigation. Flannagan recommends submitting the proposed coding structure to experts in the field and utilizing their experience to properly align the categories with the research (Flannagan 1954). Experts are not always available, so a recommended and more feasible technique is to have multiple reviewers conduct multiple examinations on the coding and analysis of the data

to improve the quality of the research. Different individuals reviewing the data multiple times provide different perspectives, insight, and systematically validate information throughout the process (Crandall 2006). Incorporating multiple researchers to codify a single data frame, in conjunction with a well-founded discussion of the study's sample size, are crucial in providing credible additions to society's body of knowledge.

G. SUMMARY

This chapter established the foundation of knowledge to develop a structured methodology. The examination of prior data collection efforts and understanding the content and sequencing of training material regarding the SBS provided insight into the evolution of the SBS program. The review of existing surveys, research, and publications identified overlap to avoid redundancy while simultaneously identifying gaps in information required for this capstone project.

Furthermore, this chapter examined various task analyses, elicitation methods, and analysis methods necessary to answer the research questions. Based on the literature review, the Applied Cognitive Task Analysis (ACTA) is best suited for less experienced researchers and takes significantly less time to elicit the knowledge required. The combination of surveys and semi-structured interviews provides a layered approach to elicit information and feedback from SBS operators. The semi-structured interviews provide the research team flexibility when interviewing SBS operators. Lastly, the commonalities between the qualitative analysis methods of a QCA, CTA, and CIT call for an iterative analysis process. Multiple analysts reviewing the data eliminates bias and subjectivity. The information collected and analyzed throughout this literature review assisted in the development of the methodology. The methodology described in Chapter III performs the necessary functions to determine the differences that exist between the way users employ the SBS system, the training they receive, and the system's training documents.

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III. METHODOLOGY

A. PARTICIPANTS

Nine of the 14 Army units were selected to participate in the research based on three criteria. First, the units agreed to participate in the SBS system data collection. Second, the participants trained on the SBS system. Third, the participants were involved in a major training exercise or operational deployment with the SBS system. The capstone team, for example, did not select 2 BCT, 4 ID because the unit did not use the system after receiving the initial training for a major training exercise or an operational deployment (Chief Warrant Officer Four, U.S. Army, email to author, June 17, 2020). Table 7 outlines the nine units interviewed and surveyed, along with the corresponding data collection methods.

Table 7. Data Collection Method by Army Unit

Unit	Location	Data Collection Method
1st BCT, 82nd ABN	Fort Bragg, NC	Interview
3rd BCT, 82nd ABN	Fort Bragg, NC	Interview
1st BCT, 25th ID	Fort Wainwright, AK	Interview
1st SFAB	Fort Benning, GA	Interview
2nd BCT, 82nd ABN	Deployed to Iraq	Survey
3rd BCT, 10th MTN	Fort Polk, LA	Survey
1st BN, 75th IN	Hunter Army Airfield, GA	Survey
3rd Special Forces Group	Fort Bragg, NC	Survey
JRTC – OPS Group	Fort Polk, LA	Survey

Among the nine Army units participating in the study, the capstone team contacted SBS users and leaders to elicit data. The SBS user involvement was voluntary. To participate in the study, individuals had to be active duty service members or DA Civilians. Furthermore, study participants must have trained on the system and employed the SBS in an operational environment. Multiple sampling methods were used to achieve the objectives of this research. Soliciting information from SBS users allowed the study to

examine events where user innovation occurred and how operators implemented NET during operations (Roulston 2010). The capstone team used three sampling techniques to identify and select prospective participants. First, intensity sampling formed the basis of the SBS user selection criteria by focusing on SBS users, managers, and leaders with experience employing the system. Second, snowball sampling increased the likelihood of collecting data from individuals with the most experience using the system. Third, convenience sampling enabled the capstone team to collect data by increasing the number of interview and survey participants based on unit and soldier availability.

A total of 27 participants volunteered to be interviewed or to take a survey. There were a total of seven volunteers for the interviews with a wide range of job descriptions. Of the seven volunteers, there were two UAS operations technicians (150U), two source intelligence analyst (35F), one electronic warfare specialist (17E), one cavalry scout (19D), and one infantryman (11B). All interview participants were enlisted and served in predominantly 1st SFAB or 82nd ABN organizations. For surveys, a total of 20 responses were recorded. The largest sample population came from enlisted infantry soldiers with 12 responses (11B). The remaining surveys consisted of two infantry officers (11A), two special forces officers (18A), three chief warrant officers (CW), and one civilian contractor. The majority of survey participants came from 10th MTN and the special forces community using the snowball sampling method. Participant ranks for interviews and surveys ranged from sergeant (lowest) to command sergeant major (highest) for enlisted soldiers. The officer ranks varied between the second lieutenant to major. Three participants were chief warrant officer fours. Lastly, there was one participant who was a civilian DoD contractor.

B. EQUIPMENT AND TOOLS

To complete the project, the team utilized two SBS systems, a computer software simulator, and multiple software packages. The primary use of the SBS systems and simulator took place during the two-day NET. Multiple software packages supported data collection and analysis. The primary platform for conducting interviews was Microsoft Teams, which has both recording and transcription capabilities. The capstone team also coordinated a contingency communications plan with the units. The participants' responses

were directly recorded into an interview transcript document using the dictate feature in Microsoft Word. The NVivo software package was the primary data analysis tool used once the transcription of interviews was complete. The NVivo software allowed qualitative data to be imported and analyzed across multiple interview transcripts and survey responses. Qualtrics software was the primary tool used for developing the surveys. Additionally, the collection of SBS users' feedback from surveys took place using the same software package. The capstone team exported quantitative responses to a Microsoft Excel document securely stored on the NPS server.

C. PROCEDURES

The capstone team created a tailored four-step methodology adapted from existing ACTA frameworks. The objective of utilizing the methodology is to determine the differences between how SBS users employ the SBS system, the training they receive on the SBS system, and the SBS system training documents. The developed methodology consists of four primary steps: analyze existing material, collect SBS user feedback, organize and validate feedback, and data analysis. An object flow in the form of a feedback loop connects the collected SBS user feedback and organizes and validates feedback steps. The feedback loop created flexibility for the capstone team by setting conditions to revisit steps if further clarification was needed. Figure 3 represents the SBS capstone project's methodology and is defined in further detail in this chapter.

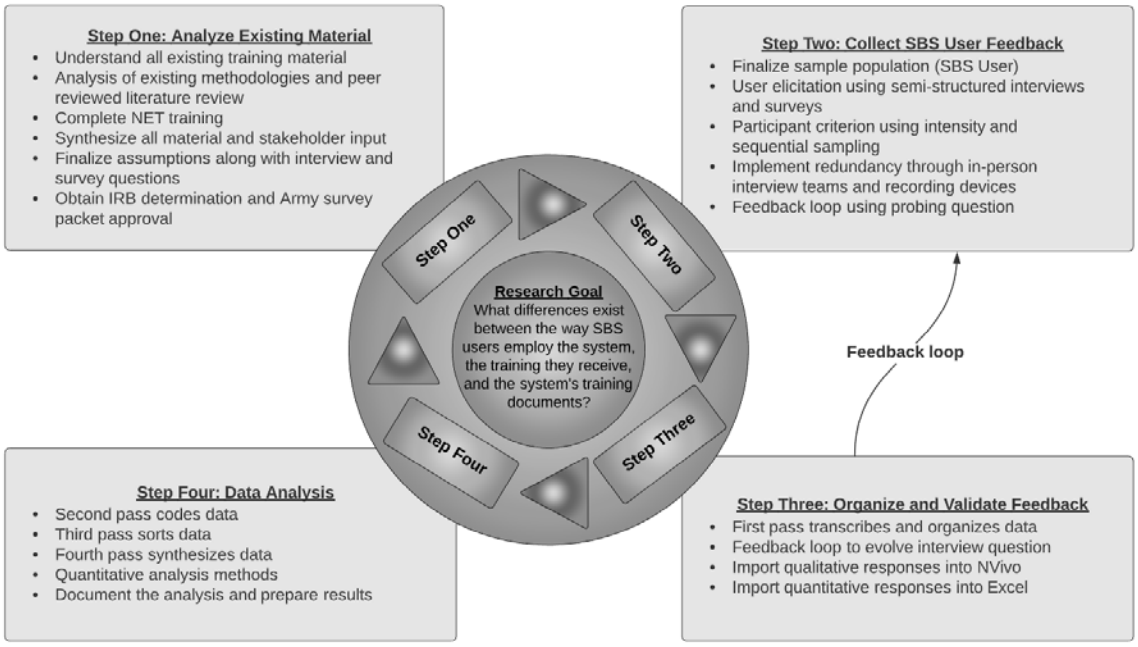

Figure 3. Four-Step Model. Adapted from Lee et al. (2017).

D. STEP 1 – ANALYZE EXISTING MATERIAL

The first step in the methodology was to analyze existing SBS research, surveys, publications, and training materials (as described in Chapter II) to develop the survey and interview questions. Included in this step was the completion of the SBS NET provided by the PEO Soldier. The training, which was the same training SBS users received, lasted two days and followed a crawl, walk, and run training methodology commonly used in the military. Training day one consisted of an overview PowerPoint brief of the SBS system, followed by practice missions on the SBS flight simulator. The training transitioned from the simulator to employing the SBS system by flying it indoors to practice GPS denied flight operations. The second training day occurred at an outdoor park and focused on the return-to-home-station function and waypoints. The training concluded with a 30-minute discussion with the NET instructor reviewing the POI and his recommendations to improve training.

Informed by the team's experience with NET and interacting with the NET trainer, the team then developed a semi-structured interview questionnaire with a total of 31 questions. The questionnaire was segmented into the following five sections: demographics (7), training (5), equipment documentation (6), employment (10), and snowball sampling (3). Each question contained a series of probes to stimulate conversation and gain additional information if necessary. The complete list of interview questions appears in Appendix E. In addition to the interviews, the capstone team developed the survey using the web based Qualtrics software. The survey consisted of 26 questions for SBS users or 28 questions for SBS leaders or managers broken into four categories. All participants answered questions in the demographic (7) and SBS training and employment (14) categories. Based on the respondent's role, they would answer the questions in either the SBS user (5) or SBS leaders or managers (7) category. The participant responses for employing the SBS determined if they received the SBS user or SBS leader or manager questions. In addition to short answer responses, the survey included multiple-choice and Likert scale questions to produce additional quantitative data. The estimated completion time for the survey was 15 minutes. Appendix F is a copy of the survey.

Once PEO Soldier approved the survey and interview questions, the survey and interview materials were submitted to the Naval Postgraduate School (NPS) Institutional Review Boards (IRB) for approval. After reviewing the research proposal and IRB packet, the NPS IRB determined that their approval was not required to conduct the interviews and survey because the board determined the information was not generalizable. The results were given to the program office and were not used for any other purpose. The IRB's determination, along with the Army Survey packet, was sent via email to the Army's Records Management and Declassification Agency, at which point the capstone team received approval and licensure.

E. STEP 2 – COLLECT USER FEEDBACK

The second step in the methodology required the capstone team to administer surveys and conduct interviews. Semi-structured interviews and surveys were the primary methods of data collection to gain SBS users' perspectives on SBS employment and training. The semi-structured interviews followed a general structure, while still affording interview participants to expand on their responses. Additionally, the semi-structured interviews allowed probing questions to gather additional information from the SBS users (Noonan 2013). While the interviews are useful for units with no network constraints, another data collection tool was needed to gather information from units with network connectivity challenges. Therefore, adding surveys into the methodology enabled the researchers to collect data from deployed units.

The project team developed interview procedures, coordinated a communication plan and schedule, and conducted checks before the interviews. All interviews were conducted in teams of two using an interviewer and a scribe. The interviews ranged from 40 to 90 minutes. The two-person interview teams did not conduct sequential interviews, which provided two primary benefits. The first benefit was that it allowed the interviewers time to consolidate notes and comments, such as non-verbal cues. The second benefit of not conducting sequential interviews is that it allowed the team time to reset and mitigate interviewer bias before proceeding with the next interview.

The surveys were distributed by emailing an access link and passcode to the two surveyed unit liaisons. The capstone team decided to use a universal link and passcode to relieve any additional burden on units willing to participate in the research. Although the team lost visibility on who completed the surveys, sending the surveys directly to potential respondents would have required the unit liaisons to consolidate the email addresses of every SBS user and leader. Each unit liaison distributed the survey link and universal passcode to the SBS users and leaders. The survey remained open for 38 days, which provided the units and SBS users flexibility to complete the survey based on their operational mission requirements. Once the survey window closed, the data was exported onto an excel sheet to be analyzed later.

F. STEP 3 – ORGANIZE AND REVIEW FEEDBACK

The third step in the methodology was to organize and review the interview and survey responses. Step three is critical to the capstone team's methodology because it transcribed the collected data from the entire sample population in an organized manner for analysis in the subsequent step. Immediately following each interview, the two-person interview team conducted the first pass of data, which verified the accuracy of the speech-to-text transcription software. The capstone team corrected discrepancies by examining the recording and interviewers' notes. The first pass served three primary purposes. First, it immediately captured relevant facts and allowed the research team to document non-verbal cues from the interview stored in the researchers' short-term memory. Second, it allowed the research team to properly format each interview transcript in Microsoft Word to maximize the automated coding capabilities of the NVivo qualitative analysis software. Third, the first pass familiarized the interview team with the collected data to identify new questions to explore in a follow-on semi-structured interview. Identifying concepts to explore during interviews allowed the team to develop additional probing questions for subsequent interviews—the feedback loop depicted in Figure 3.

After the interview, the capstone team ensured the accuracy of each interview transcript and imported it into the NVivo software's project library. The NVivo project library allowed for a single analysis across multiple interview transcripts in one dialogue window. Additionally, qualitative short answers in the survey were imported from Qualtrics into NVivo using the existing collaborative features between the two programs. The other survey responses—demographics, Likert scale, and multiple-choice—were consolidated into a single Microsoft Excel document and stored on a secure NPS server.

G. STEP 4 – DATA ANALYSIS

The fourth step of the methodology analyzed the interview and survey data to examine the differences between SBS employment, training, and documentation. Step four was the qualitative analysis process of coding data into categories, sorting categories into themes, and synthesizing the information (Saldaña 2011). During the second pass, the researchers developed an initial code structure across the interview and survey responses.

Because of the capstone team member's experience as Army Officers, the team deliberately chose to develop the first code structure after completing all data collection to mitigate researcher bias. Building the initial code structure before data collection could have created confirmation bias amongst the research team, which would have affected how the questions were asked and how the team interpreted the results. Therefore, mitigation of researcher bias took place by developing a coding structure after completing all data collection. The code structure was developed through multiple iterations due to the high subjectivity in the qualitative data analysis. Each member of the capstone team individually analyzed the same three interview transcripts and surveys to develop their code structure. The capstone team compared the five code structures for similarities and differences. The process took place continuously until the research team reached a 90% agreement on the code structure.

During the third pass, the researchers sorted the entire set of SBS user responses into the code structure developed in the second pass. Data sorted by one member of the team was verified for accuracy by another. This additional check mitigated the subjectivity and researcher bias associated with qualitative analysis while simultaneously validating the code structure to ensure no new themes or concepts emerged. The fourth pass synthesized the coded and sorted data to identify common themes and relationships across all SBS users' responses and feedback. The NVivo software streamlined the analysis by rapidly analyzing coded responses, word frequency queries, analysis of convergence and divergence of the data, and relationships among themes. Additionally, the interview data generated descriptive statistics of the sample population, including central tendency and variation in answers elicited from structured questions.

Documenting the entire analysis process was critical to ensure the credibility of the research. The capstone team's detailed records of the analysis process served three primary purposes. First, documenting the analysis allowed the team to make a determination whether the sample size was sufficient. During the coding process, the capstone team identified that new themes no longer emerged after interview transcript 5 and survey result 7; therefore, the sample size appeared to be adequate. New themes emerging in the last document coded would have indicated the sample size was too small. Second, recording the process allowed the research team to check for researcher bias or limitations of the

study. Third, the research team maintained a log of recommendations for the SBS program office or areas for future research.

The methodology described in the chapter enabled the research team to examine the data while collecting new data to answer the primary and subordinate research questions. Chapter IV contains the qualitative and quantitative analysis and results of the outlined methodology. The proceeding chapter describes the common themes from both the interviews and surveys and the different extracted between the two data elicitation methods.

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IV. RESULTS

Using the methodology described in Chapter III, interviews and surveys elicited data from SBS users. Seven participants were interviewed, and 20 surveys were completed using Qualtrics. However, two of the 20 surveys were removed from analysis. The first was eliminated because no questions were answered. The second was eliminated because the survey was 41% complete in 2.9 minutes before it was closed, suggesting that the participant did not invest sufficient time and thought in responding to the questions. Therefore, data from 25 participants were analyzed. First, this chapter addresses the project's smaller sample size and briefly describes the data analysis process. Next, the findings of the three sub-research questions are presented, which will support answering the primary research question: What differences exist between the way users employ the SBS system, the training they receive, and the system's training documents? Lastly, this chapter concludes with six additional findings identified during the data analysis.

The project's small sample size of 25 SBS operators is due to two primary factors. First, COVID-19 policies restricted accessibility to SBS operators. Because of teleworking and social distancing requirements during the time of the study, access for interviews with SBS operators was limited. Therefore, surveys were added to the data collection technique. Secondly, with the addition of surveys, approval was needed from the Army Survey Office. The approval process pushed the start of data collection of the project timeline to the right, which consequently had an impact on unit participation because the later starting date created conflicts with the unit's training schedules. The survey approval process shortened the project team's data collection window and decreased operator availability. The results presented here may not have captured all demographics important to the system. These results should be interpreted as indicative, not necessarily inclusive or exhaustive. However, the interviews and surveys could prove to be useful for future research.

The data elicited from SBS operators during the interviews and surveys were categorized and coded. The codes were short phrases developed to group the qualitative data from interviews and survey responses. As described in the methodology section, the code structure was built after the first three interviews and surveys to mitigate researcher

bias. Using the agreed-upon code structure, two project team members coded the remaining interviews and surveys, and the results were double checked by another project team member. The coding process was iterative, and the code structure evolved as the analysis proceeded. Every time the code structure was revised, the entire data set was re-coded to ensure consistency. There were no changes or revisions to the code structure after the analysis of interview five. The coding structure was similar for both the interviews and surveys. However, the interviews required more categories than the surveys because the semi-structured interview method led to a greater variety of responses. A detailed description of the code structure and the results of the interviews and surveys are in Appendix G.

A. FINDINGS OF RESEARCH SUB-QUESTION 1

How do soldiers employ the SBS system in an operational environment?

There are five employment methods identified from participants' responses regarding how the SBS system is employed in an operational environment. The five employment methods were identified as (in order from most to least frequently cited): reconnaissance (42%), security (23%), target acquisition (16%), intelligence collection (13%), and mounted operations (6%). Reconnaissance enabled operators to identify enemy personnel, suspicious activity, and enemy vehicles. Security provided operators early warning of enemy movement and protected friendly forces. Target acquisition allowed operators to identify targets, observe the effects, or adjust indirect or direct weapon systems. Intelligence collection utilized the SBS system to confirm named areas of interest. Lastly, mounted operations increased an SBS operator's situational awareness from inside a tactical vehicle.

The data suggest that the SBS system's role is expanding. As the SBS system is more widely available, SBS operators are integrating the system into missions to provide more diverse capabilities. Table 8 provides examples of narratives from SBS system employment for each employment method.

Table 8. Operator Narratives of SBS System Employment

Employment Method	Participants' Narratives of SBS Employment Methods
Reconnaissance	To gain situational awareness by observing objectives; clearing linear danger areas (LDAs) or blind spots; or clearing potential objective rally points (ORPs). (Combat & Training Environments)
Security	Base defense and base security. One participant stated, "a defensive view of the perimeter...to harden our overall defensive posture. That drastically helped us out because trying to do that with a Raven that's continuously moving versus one that you can stop and hover and look at it was a lot easier to do." (Combat & Training Environments)
Target Acquisition	Mounted gunnery with an SBS operator in the gun truck providing target location and adjust fire instructions to the gunner. Target identification and sensor queuing with other UAS platforms to call in close air support. Observe targeted areas of interest (TAIs) and to conduct call for fire missions. A participant stated, "I would have my scouts out to call when vehicles were moving and could have a system employed at obstacles. From there I would use it to call for fire without having any soldiers present or in danger." (Training Environment)
Intelligence Collection	Observing and covering an objective or named a of interest (NAI). Collecting imagery for the intelligence officer to build reports. (Combat & Training Environments)
Mounted Operations	Route clearance and investigating improvised explosive devices. One participant stated, "the Gunners in the hatch [would] launch it [the SBS system] and fly to the point take pictures look at the video. Then EOD determined based on that video, if it's an actual IED or UXO." (Combat & Training Environments)

B. FINDINGS OF RESEARCH SUB-QUESTION 2

What training do the soldiers who employ the SBS system receive?

The training soldiers receive on the SBS system was separated into two categories: initial training and unit-level sustainment training. First, initial training encompassed a formal block of training new users receive to familiarize themselves with the SBS system. Respondents received this training from the NET instructors, unit trainers, or self-taught (no formal training). Nineteen of 25 (76%) participants completed the initial PEO Soldier's NET course training. One of 25 (4%) received initial training from a trainer at the unit-level. Lastly, five of 25 participants (20%) received no formal training and taught themselves how to use the system.

Based on the sample population, the NET provided students the necessary foundation to operate and employ the SBS system. AR 95-1, *Aviation Flight Regulations*,

states that “the SBS is a self-taught system” (DA 2018a, 66). The system is meant to be a system with no formal training required. However, two of seven interviewees who did not receive initial training through either the NET or their unit exhibited limited knowledge about the system's function compared to the interviewees who completed the NET. The five interviewees who completed the NET had an average confidence level for employing the SBS system of 7.7 on a 10-point scale (1 - *least confident* to 10 - *most confident*). Similarly, 11 of 14 survey respondents were *confident* or *completely confident* when operating the system after the NET, based on a five-point Likert scale ranging from *completely unconfident* to *completely confident*.

Regarding the NET course, a master trainer said,” I think what they did was perfect to build the base the operator needs to go out and fly.” The NET course's training slides were used as the standard documentation for unit-level initial training. This ensures the NET instructors and unit trainers communicated the same information on the complex and non-standard procedures not outlined in the operator's manual. Examples of the procedures taught explicitly by the NET instructors and training slides are the follow-me, GPS denied environment operations, return-to-home, and downed air vehicle recovery.

Of the participants who attended the NET course or unit-level initial training, their responses exhibited a higher-level of technical knowledge on procedures to maximize the SBS system's capabilities. Conversely, the self-trained participants did not understand how to conduct procedures such as the follow-me, GPS denied environment operations, return-to-home, and downed air vehicle recovery; those who did not receive NET did not discover what was taught in NET during their self-training. For example, one interviewee who was a master trainer with other SUAS platform experience did not attend the NET course. During the interview, he expressed the need for a function that the system is currently capable of performing. Additionally, he expressed a low level of confidence in his ability to operate the system and stated, “that function might be in there, but like I said a little bit of [a] lack of training is probably a culprit there.” Based on the responses to SBS confidence levels, overall the initial training conducted through PEO Soldier's NET is effective, and unit-level initial training replicates the NET course using the training slides.

However, self-taught individuals lack an understanding of more complex and non-standard procedures.

The second form of training is unit-level sustainment training, which occurs after initial training. Of the sample population, 17 of 25 participants (68%) described conducting unit-level sustainment training. One respondent described the importance of sustainment training by stating, “Now, it's obviously on the unit now to build that proficiency.” Units rely on their knowledge of similar SUAS and aviation Standard Operating Procedures (SOPs) to conduct sustainment training and build proficiency. Three of the eight units had developed SBS SOPs to guide the training and employment of the system. The SBS is being integrated into unit-level sustainment training; however, the data suggest that SBS utilization occurs more frequently in collective training exercises from the company to the brigade-level. Examples include field training exercises, battalion gunneries, live-fire exercises, and range operations. Additionally, two of eight units have routine SUAS currency training where the SBS operators can simultaneously train and gain proficiency alongside other SUAS platform operators.

C. FINDINGS OF RESEARCH SUB-QUESTION 3

How do soldiers utilize the SBS system’s documentation?

The SBS is meant to be a system with no formal training requirement. AR 95-1 states that “the SBS is a self-taught system” (DA 2018a, 66). FLIR's operator's manual, FLIR's quick reference guide (QRG), and the NET-provided training slides are the three primary reference documents. The three documents are the source of SBS system information for training and serves as references in the event troubleshooting is required. When asked what he most commonly used the operator’s manual for, an interviewee stated, “I've used it to assist with teaching classes and then just a quick glance if I need to go back and do something or see something that I didn't quite remember like wind speed or just general guidelines for flying.” The participants described varying degrees of use of one, two, or all three reference documents. Units are not currently using a single-source document as the primary reference to train and assist in operating and employing the SBS system.

Only two of seven interviewees stated they used FLIR's operator's manual to assist with training and employing the SBS system. In the survey data, two unsolicited responses positively described the utility of the operator's manual. When referencing the operator's manual, one survey respondent claimed that “the manual for the [SBS system] was helpful and really all my soldiers used [it].” When asked how the operator's manuals were helpful, one interviewee, stated “it gave me everything I needed to know.” Conversely, one interviewee said that a shortcoming of FLIR's manual is the lack of national stock numbers (NSN) required to order spare parts through the Army's supply system.

When directly asked, five of the seven interviewees expressed their minimal use of FLIR's operator's manual. One interviewee alluded to the QRG as being necessary because “soldiers will never look at [the operators' manual], they will look at the quick reference guide.” When directly asked about the SBS's documentation, one interviewee stated, “Between the owner's manual and quick reference guide it has all of the information that I can probably give it to my nephew, and he would be able to figure it out.” The quick reference guide is a useful supplement to FLIR's operator's manual as it makes the most pertinent information accessible to SBS operators.

Even though operators acknowledge the usefulness of the two approved publications from FLIR, it appears operators prefer the NET training slides. An interviewee who only uses the NET-developed training slides as a guide to help with the SBS system's operation suggested that the operator's manual was not required if the training slides are available. When asked how the operator's manual assisted in the operation of the SBS, that same interviewee stated, “I don't use it, that's the reality.” When asked the same question, a different interviewee answered, “We have been utilizing the NET's power points slides because it's more of a down and dirty.” The NET-developed training slides appear to provide enough information to assist the operators in using the SBS system. Various reference documents are being used by units to train SBS operators. The lack of standardization has resulted in varying degrees of SBS knowledge possessed by operators. Different units place varying degrees of emphasis on the three reference documents, resulting in different initial training, proficiency training, and system employment.

D. FINDINGS OF THE PRIMARY RESEARCH QUESTION

What differences exist between the way users employ the SBS system, the training they receive, and the system's training documents?

This section answers the research question and highlights the alignment of the three aspects of employment, training, and documentation. The systematic evaluation illustrates the differences and similarities described by the participants of the study. The sub-questions discussed in the previous sections help to identify the differences between all three areas.

1. Differences

The data collected during the study highlighted the primary differences between the SBS system's documentation, training programs, and employment methods. The differences are outlined in the following sub-sections. Figure 4 graphically represents the differences between the documentation, training, and employment.

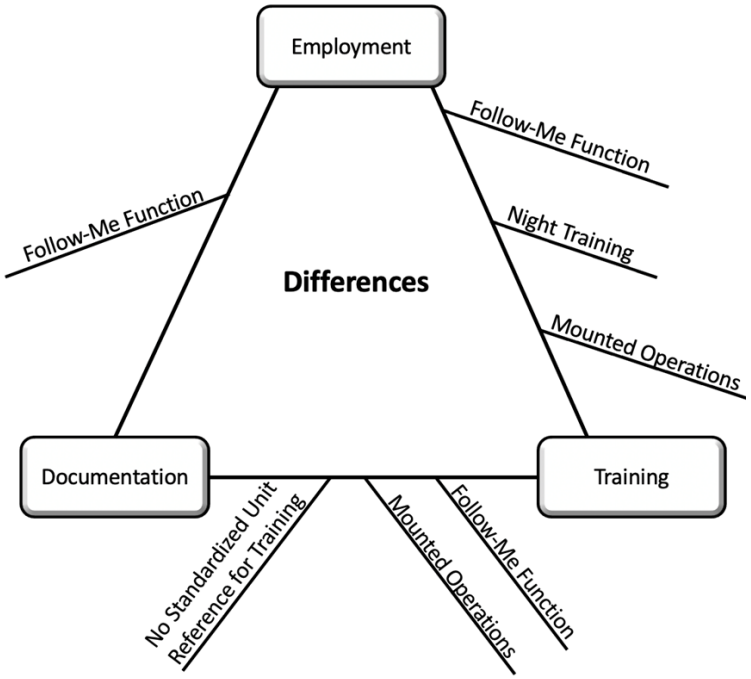


Figure 4. Differences between Documentation, Training, and Employment

a. Training and Employment

(1) Follow-Me Function Procedure.

SBS Operators who do not receive initial training from the NET did not receive training on the mission planning function referred to as the FMF by participants. Two of seven interviewees who did not attend the NET described this as a capability gap in the SBS system. Both individuals stated they were self-taught on the SBS system and had SUAS experience with other platforms. When asked about improving the system, one interviewee stated, “Would have really helped us use it [the SBS system] better would have been that kind of quick follow function.” The other interviewee stated, “One thing I wish it [the SBS system] was able to do was a follow mode. For example, you could throw it up and if you needed to move, but you don't have to move it yourself. It would just follow you or follow whoever had the GCS [ground control station] on.”

(2) Night Training Operations

While the NET teaches the procedures that are being followed to employ the SBS system, the operational context in which the system is employed is different. The NET does not train nighttime operations; however, tactical maneuver units primarily operate at night. Two participants highlighted this difference. A master trainer stated, “I think that it should be mandatory to fly it at night because...people will not be operating this asset during the day.” The same master trainer stated, “usually when they first go fly at night is when they're like on the mission. It's a little bit tricky for them to be able to complete their mission plus, at the same time learning for the first time how to fly at night.” Since the NET training course does not conduct training at night, SBS operators are not exposed to increased complexities induced by nighttime conditions in a safe and controlled training environment.

Operating in nighttime conditions is exacerbated by the payload's field of view and resolution. The nighttime procedures do not change, but the low illumination forces SBS operators to use the thermal infrared camera, which has a narrower field of view and lower quality resolution. Five participants criticized the payload's limited field of view, and nine criticized the payload as having an inadequate resolution. A cavalry scout team leader and

experienced SBS operator said, “the nighttime camera resolution was way worse. You really couldn't clear it up like you could the daytime. It didn't matter. It was always pixelated, and the field of view was smaller.” Because the NET did not provide night training to participants, they were unaware of how the change in illumination would impact their operations and how to operate within those limitations. An additional interviewee stated, “if they were flying it too high, they really couldn't tell what was going on, like they couldn't see the troops.” The SBS operators discovered during the employment of the SBS that poor payload resolution forces them to maneuver the air vehicle closer to their objective.

(3) Mounted Operations

Two participants described using the SBS system during mounted operations, are is not included in the training program. Again, the difference resides in the operational context in which users employ the SBS system. The SBS system is being utilized to support mounted operations, which is not taught by the NET, nor codified in the documentation. However, two participants described their successful employment of the SBS during mounted operations. One participant described the system's use during mounted gunnery crew qualifications. During the crew qualifications, the SBS operator assisted the gunner in acquiring targets. When asked to describe a mission that was successful because of the SBS, the second participant said, “We had most of the success stories...with the RCPs [route clearance patrols] or the QRF [quick reaction force] that are sent out to investigate that UXO [unexploded ordnance] or that IED [improvised explosive device].” In both instances, the SBS system was successfully employed using the same procedures as taught by the training program, but the operators changed the operational context by using the SBS system to support mounted operations.

b. Documentation and Training

The project identified two differences between the SBS system's documentation and training. The SBS system's documentation refers to the following three reference documents: FLIR's operator's manual, FLIR's quick reference guide (QRG), and the NET-provided training slides. At the time of the project, the Army's Technical Manual was not

available to the participants; therefore, the units relied on the commercial documentation and PEO Soldier's training material. Since, the completion of the data collection, the Army's Technical manual was published on September 15, 2020.

(1) Follow-Me Function

The procedures for the follow-me function are not outlined in the operator's manual and quick reference guide. Therefore, operators who self-train using only the QRG, FLIR's operator manual, or the technical manual will not maximize the capabilities of the SBS system. Additionally, the Army's newly approved SBS Technical Manual (TM 11-1550-261-10) does not include the follow-me function procedures. Based on the sample population's narratives, the difference is the inability to learn non-standard procedures from the system's documentation. Individuals who self-teach only gain the information published in the documentation; however, they are not trained on the most current non-standard procedures and TTPs gained through operational experience, mainly the "Follow-Me Function" (FMF). Two participants described the value of having an FMF, but because they self-trained using the operator's manual and quick reference guide, they were unaware the SBS had a FMF mode. Knowledge of the non-standard procedure, FMF, would allow the SBS system to automatically allow the base station without needing an operator to maneuver the SBS system. The FMF is advantageous to tactical units that encounter an enemy force; soldiers could focus on returning fire or maneuvering. They would not be distracted by flying the SBS system back to the base station before engaging in either of those activities. During NET, the instructors teach the mission planning function, which is a capability that can be manipulated to get the SBS system to follow the base station. However, participants are not taught the mission planning function consistently across the three types of initial training. Furthermore, the FMF procedures are not codified in the NET published documents. The absence of FMF procedures in the formal SBS documentation results in self-trained operators being unaware of this important function.

(2) Mounted Operations

The newly published SBS system TM states, "The UAS is designed specifically for dismounted operations" (DA 2020, 1). However, two participants described successfully

utilizing the SBS system during mounted operations. The operational context and manner in which the two participants trained and employed the SBS system does not align with the documentation. Using the SBS system during mounted operations is an example of soldiers discovering unanticipated ways to accomplish their mission outside the purposes specified in the documentation.

(3) No Standardized Unit Reference Material for Training

There is no formal document standardizing unit-level initial and sustainment training. The lack of standardization resulted in varying degrees of SBS knowledge and system capabilities from participants. The varying degrees of SBS knowledge can depend on which document a unit has available, or how the unit chooses to train their operators. A Brigade UAS Operations Officer expressed the need for establishing a training standard by one of the Army's Centers of Excellence (CoE). The interviewee stated, “There must be someone out there that develops a program of instruction that is the standard for the SBS. I think MCOE [Maneuver Center of Excellence] should develop a training program of instruction standard. Right now, there is no standard; training varies between units.”

c. Documentation and Employment

(1) Follow-Me Function

Similar to the difference between the documentation and training, the lack of codification of the FMF in the documentation does not allow self-taught operators to maximize the capabilities of the SBS system in operational environments. Since the function is not in the documentation, the self-trained operators do not know how to execute the FMF procedures during training or employment of the SBS system.

2. Similarities

There are many similarities between the SBS system’s documentation, training, and employment. However, this section will only highlight four similarities, which are graphically depicted in Figure 5.

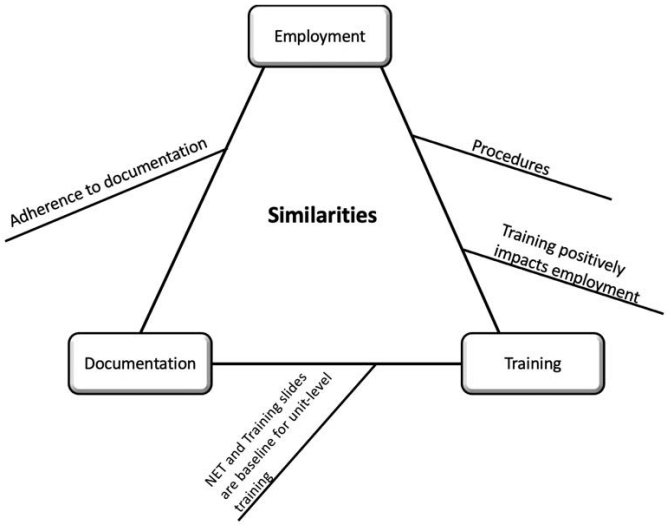


Figure 5. Similarities between Documentation, Training, and Employment

a. Training and Employment

(1) Training an Employment Procedures Are the Same

Procedurally operators are employing the system in the manner in which they are taught. For example, operators conducted a down aircraft recovery exercise during the NET. The operators located the aircraft by following the procedures from the last known GPS location and activating the beacon. Participants were asked if they had ever performed a down aircraft recovery during operations. An operator responded they were able to locate the aircraft based on the GPS location procedures taught during the NET. Participant narratives share that they are expanding upon their training to use the SBS in different scenarios. But even though they are expanding the use of the SBS in other operational contexts, participants are using the steps taught in training to execute the mission tasks.

(2) Training Positively Impacts Employment

As units gain familiarity and routinely employ the SBS system, they are refining their tactics and employment. One participant stated, “It [the SBS] was part of every pre-mission brief we had. They [leaders] always included the SBS, and we knew exactly when or where we would employ it.” The pre-mission planning included pre-loading buildings or targets of interest as waypoints before missions in a combat zone. Additionally, another

participant said, “It's always part of our basic defense plan and then just METT-TC [mission, enemy, troop, terrain, time, and civilian consideration] whether we actually used or not.” As both training repetitions and operators' confidence in the system continue to increase, units are experimenting with different uses for the system. The following are a few examples: including SBS operators in gun trucks; exploring uses for building and room clearing operations; using the SBS tail beacon to distract enemy during night operations; or placing infrared markings on the airframe to locate a downed air vehicle at night.

b. Documentation and Training

(1) The NET PoI and Training Slides Are the Baseline for Unit-Level Training

Two of the seven interviewees (a brigade UAS Operations Officer and battalion master trainer) were responsible for developing and/or implementing their unit SBS SOPs. Both participants preferred to use the NET training slides as their primary reference document. When asked to describe their unit-level initial training, the battalion master trainer answered that “they had a PowerPoint for every single bit of info that they could ever think of,” supporting the notion that the NET's training slides provide enough information to facilitate the operation of the SBS. The NET's training slides are easy for PEO Soldier to maintain with the most updated information.

c. Documentation and Employment

(1) Adherence to Documentation

SBS operators are operating the SBS within the system limitations described within the documentation (i.e., operator's manual). For example, the SBS system's specified endurance (battery life) is 25 minutes (DA 2020). A first sergeant reported, “They [SBS operators] know that they have 10 minutes at best if it's a little bit windy and they have to fight the wind on the way back to the recovery point…now they're thinking I have anywhere between five and eight minutes of really flying this thing.” The participants know and are adhering to the specified system limitations. Furthermore, SBS operators are accounting for the limitations when planning for and employing the SBS system.

E. ADDITIONAL FINDINGS

This section provides six additional findings from the data analysis not directly tied to the research questions. The findings are synthesized themes across the interview and survey data. The section begins with an analysis of the SBS system's future configuration because it was directly requested by the PEO Soldier— the primary stakeholder. As the section proceeds, the remaining five findings are described in progression across both the training and employment, as well as factors which hinder both SBS system training and employment functional areas.

1. Participants' Recommendations for Future SBS Systems

To assist PEO Soldier in developing the SBS system's next variant, respondents were asked about their preference for the number of air vehicles included in the system. Ten participants preferred a single air vehicle, 11 participants preferred two air vehicles, and two preferred three air vehicles. The participants also identified system limitations that should be addressed in future designs. The five cited most often and the number of times they were mentioned by participants are as follows:

- The payload's poor resolution and limited field of view (20 times).
- The short battery life or mission endurance as a hindrance to mission accomplishment (18 times).
- The SBS system's inability to operate in windy conditions (14 times).
- The line-of-sight mission range (12 times).
- The propeller's durability (seven times).

2. Feedback on the SBS System NET

As previously stated, 19 of 25 (76%) of the participants completed their initial training through PEO Soldier's NET course. Based on participants' responses, they appeared satisfied with the two-day course structure, including a weather day, the instructor-to-student ratio, the inclusion of the simulator in the training, and the multiple

practical exercises during hands-on training. Additionally, NET training slides were very detailed and provided a useful reference for unit-level initial and sustainment training. However, the participants provided four recommendations to improve the NET:

- Additional repetitions and hands-on practical exercises (six participants).
- Training in nighttime conditions (two participants/five times).
- Ensure all students use the simulator before operating the SBS system (one participant - a master trainer).
- Incorporate more comprehensive airspace management instruction to ensure operators have a better understanding of deconfliction procedures (one participant).

3. Lack of Simulator Interoperability and Accessibility Hinder Training

The SBS operators cannot install the simulator software program from a USB drive on a government network. Therefore, the simulator software must be installed on a stand-alone computer with adequate processing power. Participants described these simulator issues 15 times. Units are overcoming the limitations of the simulator software availability by installing the simulator on their Aviation Mission Planning System (AMPS) computers or personal computers. One participant stated, “I have to put it in a personal computer.” Another unit tried to install the simulator software on their Panasonic Toughbook laptops for Raven and Puma. This approach was unsuccessful because those laptops run on Windows 7 and the simulator software requires Windows 10.

Despite the limitations, units and SBS operators still value the simulator to aid initial training and sustainment training. The participants made 22 positive comments about the simulator. One participant stated, “More people will be willing to self-teach [on the SBS system], if the simulator was easier to access.” In addition to building a base of knowledge in initial training, units institute simulator currency requirements to maintain operator proficiency and build operator confidence with the system. One unit requires their operators to use the simulator before flying the SBS system as a local policy.

The data suggest that the integration of the simulator into training provides four primary benefits. First, the simulator helps establish a baseline knowledge of the SBS operations and controls. Three of 14 survey participants who attended the NET did not use the simulator. These three individuals selected *neutral* as their confidence level with operating the system at the completion of the NET on a five-point Likert scale ranging from *completely unconfident* to *completely confident*. These were the only three survey respondents who selected a confidence level lower than *confident.* Second, the simulator helps operators maintain proficiency and build operator confidence. The increase in proficiency and operator confidence leads to the third benefit, a reduction in crashes. Fewer crashes reduce system cost and disruptions to collective training events. A participant stated, "The [simulator] software a let me [fly the SBS] without worrying about crashing it. It also helped to understand the controls. I wish we had one now." The' simulator's fourth benefit is that the training device allows units to continue training while improved range control procedures are implemented to enable flight training on the installation.

4. Unclear Logistics Procedures Decrease Operators' Confidence and Usage

Units and SBS operators do not understand the logistics procedures to replace broken components or requisition additional authorized equipment. This issue is compounded by the fact that the FLIR's operator's manual does not contain the national stock numbers (NSNs) for the SBS's components. Participants described 19 instances of unclear logistical procedures and a shortage of repair parts. Furthermore, participants described a need for the extended range antenna and BB-5590 battery charging cables to expand capabilities to improve mission accomplishment. The extended range antenna increases the LoS mission range of the system and the BB-5590 provides charging capabilities from a tactical vehicle. The participants described the need for the additional authorized items 18 times.

The unclear logistics procedures have two primary impacts on the operator's training on, and employment of, the SBS system. First, the lack of clarity decreases leaders' willingness to train operators and employ the system. A participant reported that the biggest challenge with the system was the "fear of higher-level leaders from employing the system

due to fear of loss." The second impact of unclear logistic procedures is that it decreases SBS operators' confidence in employing the system. Thirteen responses indicated a lack of operator confidence and decreased utilization because of the fear of equipment damage or loss. Units and operators are hesitant to train on the system and push its limits. One participant stated, "It's a cool system, but me personally I'm afraid to break it because I don't know how long it's going take for me to fix it and how much it's going to cost."

5. Inconsistencies in Units' Operating Procedures

There is some confusion among SBS operators and units on how to manage the SBS system. AR 95-1, Aviation Flight Regulations, provides regulatory guidance defining no formal qualification training, formal training plan, currency requirements, or annual proficiency evaluations for the SBS (DA 2018a). However, the unit's familiarity with other SUAS—such as the Raven, Puma, or Shadow—and embedded aviation Officers and Warrant Officers on the brigade staff tend to result in the development of similar qualifications, training plans, and currency requirements for SBS.

Lower echelon units are prohibited from subtracting from the regulations but are permitted to add supplemental procedures. Two units, however, that developed formal SOPs closely mirrored other aviation regulations. These SOPs instituted qualification training programs and currency requirements. Four of seven interviewees suggested that standardized currency training would help maintain proficiency, reduce damage to equipment, and increase operator's and leader's confidence in the SBS system. One brigade includes the SBS in currency training with the Raven and Puma systems. Publication of unit standardized training programs, train-the-trainer material, and procedural training software was mentioned 11 times by participants. Units are looking for guidance on how to manage the training of the SBS system. Inconsistent unit-level operating procedures negatively impact the training and employment of the SBS system.

6. Installation Airspace Procedure Inconsistencies

Airspace management agencies - both home station and deployed - are experiencing the same learning challenges as the units. AR 95-1 states, "Personnel operating SBS will not be required to receive any familiarization training in airspace and airspace management

due to the small size/weight and low operating altitude of the SBS" (DA 2018a, 66). However, SBS operators and units are still required to abide by expanded regulatory guidance of local airspace management agencies. A brigade-level UAS Operations Officer stated, "Right now, the biggest deterrence from training is going to be the range request process." Eleven participants indicated that range control or base operations offices' limitations hindered their training or employment of the system. One participant described the limitations placed by range control as, "They see it as a fully functioning aircraft and require the same radio transmissions as a normal helicopter. Absolutely unnecessary." Another participant stated, "Pilots are extremely nervous about these kinds of devices. They [range control] won't let us fly them [the SBS] at the airbase even though they would be extremely helpful for defense."

Conversely, other installations are less restrictive on the SBS system's employment, creating inconsistency and confusion. As one participant described, "We will never get rid of this requirement but what we can do to make it easier is to come up with procedures that will enable training. The more red tape you put around the procedures to fly the SBS, units will not fly it... If it was easier to arrange training, then the units would use it more. If you want to enable more training, make it easier for them to train." Units are working with range control and airspace controlling agencies to educate the agencies and develop a plan to remove some unnecessary restrictions placed on SBS operators to enable training. Three of seven interviewees described positive interactions with airspace agencies supportive of the SBS system's training and employment. One participant provided an example of less restrictive procedures conducive to training and employment by stating, "They [Joint Readiness Training Center] mandate that SBS operate below the highest obstacle height. If the training unit is around trees, they cannot fly the SBS above the trees. If they are close to buildings, they cannot fly the SBS above the highest building." Inconsistent air space management procedures negatively impact the SBS system's training and employment and, ultimately, the warfighter.

V. SUMMARY, CONCLUSION, AND FOCUS AREA FOR FURTHER RESEARCH

The purpose of the research was to inform the program office if users were employing the SBS in unanticipated ways based on the current training and system documentation. This research reviewed existing training documentation, the NET course, and previous system surveys. The research team designed and conducted surveys and interview with 25 SBS system operators and managers. The responses from seven interviews and 18 surveys were categorized according to five functional areas to identify differences and similarities among the documentation, training, and employment of the SBS system. Specifically, the information gathered was analyzed to determine whether users employ the SBS in operational environments differently from the manner described by the publications and the training curriculum. Additionally, the program office requested an assessment of whether SBS system operators prefer the current system configuration, consisting of two air vehicles, or a different configuration.

Analysis of the results revealed that differences exist among the way users employ the SBS system, the training they receive, and the system's training documents. The intended design and employment of the SBS system is to increase situational awareness within a squad-sized formation with minimal operator training and no installation range approval. A notable difference between employment and training is the information presented in different initial training methods (i.e., NET, unit, and self-taught) varies and appears to impact the manner in which the SBS is employed, specifically regarding the FMF technique. Additionally, differences with installation approval processes to employ the SBS system hinder many operators and units from making use of training opportunities.

Based on the analysis of results, recommendations were provided to PEO Soldier from the project team to assist units with training and installation clearances. Furthermore, results also suggest that additional studies should be conducted regarding airspace flight restrictions on the SBS system and a study on system employment later in the system's lifecycle when more units have been issued the SBS system and simulator. A research limitation of this study was the researchers could collect data from only six units that had

been fielded the SBS. Additionally, the number of respondents within those units were limited due to operator availability. The COVID environment precluded travel to unit locations; therefore, all interaction with SBS operators occurred online or via telephone.

A. CONCLUSION

The project first examined the SBS system's training, documentation, and employment methods. The initial training soldiers receive on the SBS system is delivered through three primary method: the NET instructors (76% of participants), training at the unit-level (4%), or self-taught through the system documentation (20%). Both the NET course and unit level training generally follow the same material and training slides. However, operators who self-teach do not learn non-standard procedures, which are learned through experience and are not published in the documentation. After initial training, the units build operator proficiency and confidence through unit level sustainment training, generally during collective training exercises. The experience gained through training allowed the participants to employ the system in an operational environment to conduct reconnaissance, security, target acquisition, intelligence collection, mounted operations.

After independently examining the SBS system's training, documentation, and employment, differences were identified among the three. The documentation does not outline all non-standard procedures; additionally, there appears to be no standardized method for unit-level initial and sustainment training, in accordance with AR 95-1. However, participants sought guidance on how to standardize training. While the procedures taught in the NET course are being followed to employ the SBS system, the operational context in which the system is employed is different. Employing the SBS during night and mounted operations is procedurally the same, but more complex for operators. A final difference identified non-standard "follow me function" (FMF) procedures which are not outlined within the systems documents. This discrepancy resulted in different levels of operator technical proficiency which impacted both training and employment.

B. RECOMMENDATIONS FOR PEO SOLDIER

Recommendations for possible training modifications and user employment methods to shape future versions of the SBS system are listed below.

- While no distinct preference between one or two air vehicles were stated, consider the limitation identified by the participants. The specific recommendations are listed in Chapter V, Section E.
- Add additional repetitions and night practical exercises to the NET course to improve SBS operator's baseline knowledge and confidence in the system.
- Consider alternate methods of distributing the simulator software to increase access to the units.
- Consider working with installations airspace management agencies to alleviate some of the restrictions and better enable unit-level training of the SBS system.
- Coordinate with the appropriate CoE to provide further guidance on training requirements.
- Publish the process for ordering replacement parts, additional authorized items, and funding approval clarification for units.

C. RECOMMENDATIONS FOR FUTURE RESEARCH

The results of this project indicate that the SBS system training programs and employment methods are evolving as the number of training events and operational deployments with the system increase. The SBS system is a program in its infancy and efforts must remain focused on providing needed capabilities to the warfighters and setting the conditions to enable learning and training on the system. Based on the information elicited through interviews and surveys of sample population, there are two recommendations for future research.

First, analyze how airspace control procedures differ across the different U.S. Army installations and whether a level of standardization can be achieved. The objective of this research would be to establish a more conducive environment for training and employment of the SBS system. For a system with no formal training requirements, this study's participants described multiple instances of how installations' range control procedures hindered their employment of the SBS system.

The second recommendation for further research is to conduct a study similar to this capstone project, but later in the SBS system's operations and support lifecycle. Allowing the system to mature provides four benefits to further enhance PEO Soldiers' understanding of the training and employment of the SBS system. First, PEO Soldier and the NET will continue to field and train additional units. As additional fielding occurs, a future study can elicit information from an expanding population of users. Second, conducting a similar study later would allow units time to train and deploy with the system, thereby allowing additional opportunities to refine their TTPs, SOPs, training plans, and employment methods. Third, a second study would allow units time to receive, comprehend, and use the Army's approved SBS TM. The Army's TM should provide additional clarity on the SBS system's logistic procedures. And fourth, such a study would provide additional time for simulator interoperability issues to be addressed, which, in turn, would permit units additional time to fully implement the SBS simulator into their training plans. The results of the second, proposed study could be compared to the results of the study reported herein to determine the extent of the progress made in fielding and employing the SBS system.

Finally, a limitation of this study was using surveys and VTC interviews, which decreased participation and the depth of responses. Future studies should elicit data through in-person interviews to increase participation while continuing to gain detailed narratives from SBS operators.

APPENDIX A. SURVEY 1

MANEUVER BATTLE LAB

In Theater SBS Altitude Assessment

Date_____ **Time**_____

OPERATOR DEMOGRAPHICS:

Operator's Last Name:_____ First Name:_____

Rank:_____ MOS: _____ Platoon:____ Company:____ Battalion:_____

Duty Position:_____

Operator's time in service: ___ Years ___ Months

Does operator wear prescription lenses: ___ Yes ___ No

If Yes: ___ Glasses ___ Contact Lenses

Experience level with unmanned air systems

None……(Never operated other than New Equipment Training NET)
Novice……(1-15 flights)
Moderate……(16-30 flights)
Expert……..(Over 30 flights)

System	**Experience level** (Check all blocks that apply) None	Novice	Moderate	Expert
_____	☐	☐	☐	☐
_____	☐	☐	☐	☐
_____	☐	☐	☐	☐
_____	☐	☐	☐	☐

Flight Conditions (Check the block that applies)

Day ☐ Night ☐

Wind: 0 MPH ☐ 1-5 MPH ☐ 6-10 MPH ☐ 11-15 MPH ☐ 16-20 MPH ☐ 21-25 MPH ☐ 25 MPH + ☐

Did the Soldier Borne Sensor need to fly at a higher altitude than it was flown at for the mission? ☐Yes ☐No

Why? _____

_____

_____

_____

_____

_____

Additional Comments

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

APPENDIX B. SURVEY 2

New Equipment Training – Student Evaluation

System: _____

Part I-General Course Information

1. Instructors: _____
2. Location of Training: Installation: _____ BLDG #: _____
3. Unit of Assignment: _____
4. MOS: _____
5. Date of training was from _____ thru _____

Part II-Course Material **Please select all that apply**

6. Technical value was: POOR FAIR GOOD VERY GOOD EXCELLENT
7. Course objectives and purpose were:
   - ☐ about right for my technical level
   - ☐ too technical
   - ☐ too elementary
   - ☐ adequately explained
   - ☐ marginally explained
   - ☐ not explained
8. Course is: TOO LONG TOO SHORT ADEQUATE LENGTH
9. Course material is considered to be:
   - ☐ Outstanding
   - ☐ Adequate
   - ☐ Not adequate and can be improved (please explain): _____

Part III-Course Presentation **Please select all that apply**

10. Was the classroom presentation adequate and timely? YES NO
    - ☐ too long ☐ too short ☐ long enough
11. The lecture portion was:
    - ☐ very well presented
    - ☐ adequately presented
    - ☐ poorly presented
12. The instructor:
    - ☐ followed the subject
    - ☐ didn't follow the subject
    - ☐ gave the opportunity to ask questions
    - ☐ didn't give the opportunity to ask questions

New Equipment Training – Student Evaluation

13. Instructor's presentation was:
- ☐ easy to follow
- ☐ difficult to follow
- ☐ easy to understand
- ☐ difficult to understand
- ☐ interesting
- ☐ uninteresting

14. The instructor was:
- ☐ outstanding / professional
- ☐ respectful
- ☐ a good communicator
- ☐ poor
- ☐ weak / rude

15. The amount of practical exercise was:
- ☐ too long
- ☐ the right amount
- ☐ not enough

16. If you could, what would you change to improve the presentation? (please make some comments)_____

_____

_____

Part IV-Opinion of overall course, remarks and recommendations **Please select all that apply**

17. My opinion of the course is: VERY GOOD GOOD FAIR POOR

18. Do you feel you have been adequately trained to use this equipment? YES NO

19. My comments on the instructor's platform technique: _____

_____

_____

_____

20. Will you be able to train Soldiers on this equipment? If not, please explain why:_____

_____

_____

21. ***OPTIONAL*** Name, Rank and contact information:

_____

_____

_____

APPENDIX C. SURVEY 3

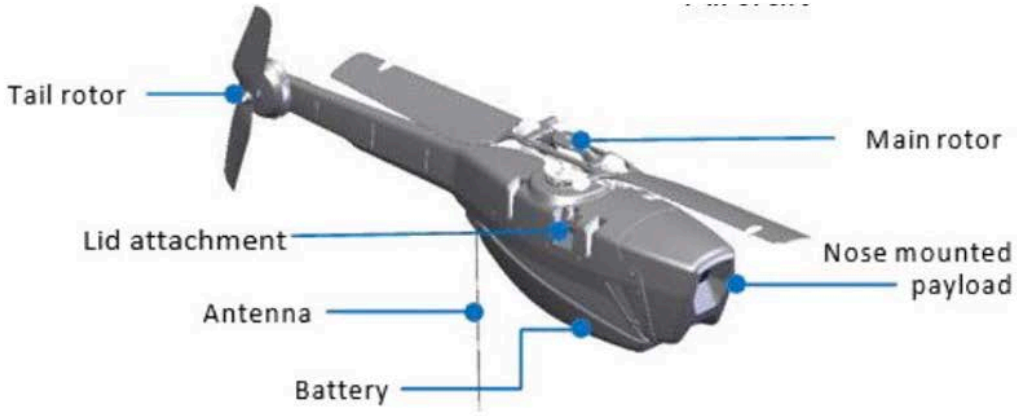
BDE: **BN:** **CO:** **SQD:** **Rank:**

Soldier Borne Sensor Questionnaire

Key Output of Questionnaire: Provide operational relevant feedback of the Soldier Borne Sensor from current users in support of potential future upgrades.

1. How often does your unit bring the Soldier Borne Sensor on mission?
    a. Every time
    b. Most of the time
    c. Some of the time
    d. Never

2. Of the missions where the Soldier Borne Sensor was equipped, what percentage of missions was it employed?
    a. 100%
    b. >75%
    c. >50%
       >25%
    d. <25%



3. Circle the components on the AV that have failed during launch, flight, or recovery of the AV. Explain the circumstances with frequency.

A3. Sideways left

A4. Sideways right

B1. Forward

B2. Backward / Stop & Hover

B3. Rotate left

B4. Rotate right

D1. Climb

D2. Descend

4. How do you asses the ergonomics and control layout on the hand control to adequately maneuver the AV?

5. Do you think the AV would be easier to operate if it had an integrated controller similar to the Nintendo Switch or Moto-X controller? (controls are integrated on the side of the display) Explain.

6. How often did you experience loss of link with AV without the Omni Antenna installed?

   With the Omni Antenna installed?

7. What do you suspect the cause for Loss of link? (line of sight, distance from operator, jamming, failing to orient controller?

8. How often did you experience issues aligning the GPS? What did you do to alleviate GPS issues?

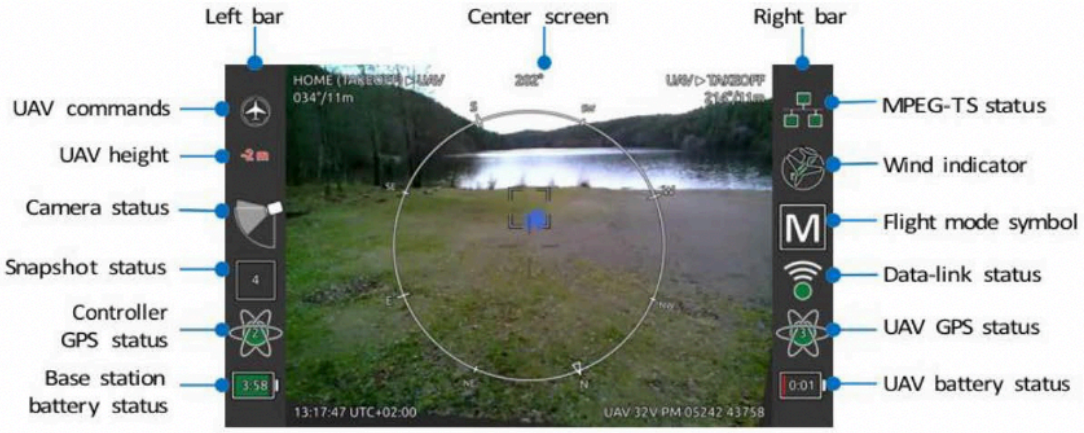
9. If you experienced a loss link……(circle all that apply)
   a. I had a lost link way point set
   b. The AV returned to the lost link point
   c. The AV was lost and recovered using AV “Beep” or LED “Blink”
   d. The AV was lost and not recovered
   e. Other:_____

10. Did you utilize the GPS denied mode of navigation?

11. How long were you able to fly on average with a fully charged AV?

12. What was the longest and shortest flight executed where you had to return the AV to the point of launch due to low battery?
    a. Longest_____Minutes
    b. Shortest_____Seconds

13. What were some of the factors that decreased the expected flight time as it pertains the battery life? (winds, heat, frequency of use….)



14. What improvements, if any, would you make the operations screen?

15. How often did the winds adversely affect the AV while on mission?
    a. Every time
    b. Most of the time
    c. Some of the time
    d. Never

16. The wind limitation for the Soldier Borne Sensor is 15 knots. Did you or your leadership reduce the limit for which you would decide to employ the AV based on your experiences? Explain.

17. Did you utilize the mission planning features to build waypoints/routes? If so, how often? (every flight, half the flights, some of the flights, no flights) Explain your reasoning.

18. Did you utilize the video playback or snapshot feature while on mission or when the mission was complete? Did it enable you to achieve objectives?

19. What percentage of the flights did you use Electro optical viewing and Thermal viewing?

20. At what altitude did you normally fly the AV and did the camera provide the necessary visual acuity for you to determine the object or personnel you were attempting to view? Did you have to decrease altitude to increase acuity? Explain.

21. Did you ever download video to a stand-alone computer for mission debriefs?

22. What other non-typical errors have you experienced that could not be immediately solved that cause you to not execute the flight? (AV would not sync with base station)

23. Did you ever experience failures with mounting fasteners on the base station or tactical display pouch?

24. In your own words, please explain what you like most about the Soldier Borne Sensor.

25. In your own words, please explain what improvements you would like to see in the Soldier Borne Sensor.

26. Any operational stories, good or bad, that you would like to share about using the Soldier Borne Sensor:

APPENDIX D. SURVEY 4

BDE: BN: CO: Position (circle): CO CDR XO PL PSG

Soldier Borne Sensor (Black Hornet) Leader Survey

Key Output of Questionnaire: Provide operational relevant feedback of the Soldier Borne Sensor from current Leaders in support of potential future upgrades and implementation.

The objective of the Solider Borne Sensor was to provide the squad with an organic "quick look" capability to scan larger operational areas without the delay of coordinating with non-organic assets.

The SBS provides a near-term solution to three Army Warfighting Challenges (AWFCs) in order to enhance the lethality and force protection of the Infantry squad are:

- AWFC 1: Develop Situational Understanding
- AWFC 11: Conduct Air-Ground Reconnaissance
- AWFC 15: Conduct Joint Combined Arms Maneuver

1. How familiar are you with the limits and capabilities of the Soldier Borne Sensor?
   a. Extremely Familiar
   b. Somewhat Familiar
   c. Not Familiar
2. Did you incorporate the Soldier Borne Sensor into the planning phases during mission preparation? If yes, how did your planning change through the deployment?
3. What percentage of your missions did you equip the Soldier Borne Sensor?
   a. 100%
   b. >75%
   c. >50%
   d. >25%
   e. <25>
4. What percentage of your missions was the Soldier Borne Sensor employed?
   a. 100%
   b. >75%
   c. >50%
   d. >25%
   e. <25>
5. Did you change the way the Soldier Borne Sensor was employed during the deployment? (courtyard SA, UXO/IED investigation, Buildings)
6. Did the Soldier Borne Sensor aid in achieving your mission objectives? Explain.
7. Did you view the Soldier Borne Sensor as a hindering or mission enhancing system? Explain.

8. What are some of the factors that kept your element from employing the Soldier Borne?

9. Did you utilize the video playback or snapshot feature while on mission or when the mission was complete? (downloading saved FMV/Pictures)

10. Did you provide any FMV/Pictures to the intelligence cell or use the FMV to aid in planning future missions?

11. In your own words, please explain what you like most about the Soldier Borne Sensor.

12. Any operational stories, good or bad, that you would like to share about using the Soldier Borne Sensor:

13. What was your overall experience will the Soldier Borne Sensor?

APPENDIX E. INTERVIEW QUESTIONS

DEMOGRAPHICS

1. What is your MOS?
2. What position were you serving in while using the SBS system (e.g., RTO or rifleman)?
3. What type of platoon/unit were you assigned to while using the SBS?
4. What is your current rank?
5. How long have you been in the military?
6. How long has it been since you last used the SBS system either in training or mission?
7. Do you have experience with commercial drones or flight simulator games?

TRAINING

We're now going to start with the first research area: training, both NET and unit level training.

8. Tell me about the initial SBS qualification training you received (NET/unit-led).
    a. Who conducted it?
    b. What kind of training was it (classroom, simulation, hands-on)?
    c. How long was it?
    d. On a scale from 1–10 (10 being the highest confidence) how confident did you feel with executing the learned tasks? ***Move to bottom after all training questions have been asked?***
    e. What would you do to improve the training?

    If hands on ask these additional follow-on questions:

    f. Did every student in the class get to conduct hands-on flight training?
    g. Did that impact your ability to learn or control the SBS?
9. Do you believe the SBS simulator is useful, and, if so, describe how did it improve your understanding?
    a. Is there something that can be done to improve the simulator?

b. What is the most important thing you have learned using the simulator that transferred into your training or operational employment of the SBS?

10. After you were initially trained on the SBS system, did the unit ever schedule sustainment training on the equipment (i.e., platoon training, sergeant time training, individual Soldier proficiency)?
    a. Please describe the type of unit training and at what level was it conducted.
    b. Was there any specific part of this training that assisted in operations while deployed or field exercises?
    c. Do you have any recommendations to improve unit sustainment training?
    d. Is there anything that has restricted your ability to conduct sustainment training?
11. Did you use the SBS during your CTC rotations or field training exercises?
    a. What type of training event was it and at what level? (squad, platoon, company, battalion...)
    b. What was the mission and how did you employ the SBS?
12. Describe the biggest maintenance problem for the SBS?
    a. Describe why or why not the operator's manual helped?
    b. Can you describe how this maintenance was modified in a deployed or field environment?
    c. Can you describe a time when you had to adjust how you operated the system to avoid this maintenance problem?
    d. Have you found any creative way to minimize maintenance problems while employing the SBS system?

Equipment Documentation (TM, Operating Manual, SOPs)

Next, we are going to ask a series of questions about the equipment documentation.

13. How did the Operator's Manual assist with operations and provide an example?
14. What did you most commonly use the manual for? (basic functions, PMCS...)
    a. Was that included in the initial qualification training?
    b. Did you ever encounter a situation where you did not find the answer in the manual?

15. At the team, squad, platoon, or company level did you develop any additional SOPs, smart cards, training aid, etc., for the SBS?
    a. Can you provide an example [take a picture/get a copy]?
    b. How did the unit-developed SOP, smart card, training aid, etc., enable you to accomplish the mission?
16. Based on the many uses of the SBS have you included it into existing battle drills, TTPs, or SOPs? If yes, please describe.
17. Have you participated in any currency training as a dedicated SBS operator?
    a. Does your unit have a currency requirement (fly every 30, 60, 90-days, etc.)?
    b. Do you think the currency requirement helped you with your confidence levels on the use of the SBS?
    c. Does your unit have any annual evaluation criteria to maintain your qualification?
    d. Can you provide an example of the evaluation or explain how the evaluation was given (i.e., multiply choice test)?
18. Is there anything you would add to the operator's manual or the SOP and what specifically would include?

SBS Employment

19. What was the nature of your unit's mission (route clearance, armed escort, patrol)?
20. Was the SBS included in mission planning, if so, how? (explain what mission planning is if you feel it necessary)
21. What types of missions did you most use the SBS for? (base defense, TCP, route clearance...)
    a. In the example provided, how was the SBS used? (clearing culverts, checking vehicles, clearing dead space)
22. Describe a mission that was successful because of the SBS?
    a. Why did the SBS make the mission successful?
23. Can you think of a time when the SBS hindered a mission? (delayed a mission, stopped a mission, put personnel at risk)
    a. What caused this event?
    b. How did you overcome the challenge?

c. Is the payload resolution sufficient to conduct recon of an objective?

24. Did you use the system the way you were taught during initial qualification or sustainment training?
    a. If no, what task(s) did you modify to get the SBS system to do what you wanted it to do?
    b. Why did you have to modify those task(s) (i.e., weather, enemy tactics, other factors)?
25. Think of a time you had to recover a downed SBS. Can you describe the event(s)?
26. For a future SBS configuration would you prefer:
    a. The existing configuration - Two air vehicles. One air vehicle with Electro-Optical (EO) sensors and one air vehicle with both EO and Thermal Imaging sensors. (1)
    b. A single air vehicle configuration - One air vehicle with both Electro-Optical and Thermal Imaging sensors, but capable of providing the same amount of mission coverage (twice as long as the existing air vehicles). (2)
    c. Other configuration (Please describe) (3)
27. Is there anything not covered in the interview that you would like to expand on at this time?

Questions Supportive of the Snowball Sampling Method

28. Is there anyone else who comes to mind you would consider as proficient with the SBS system who would be beneficial to talk to?
29. Do you have their contact information?
30. Can you ask them if it is ok if we contact them?

APPENDIX F. INTERVIEW TRANSCRIPTS

Naval Postgraduate School
Consent to Participate in Research

Introduction. You are invited to participate in a research study entitled *Analysis of Soldier Borne Sensor Employment and Training Program.* The purpose of the research is to compare the SBS training program to the employment of the system in an operational environment.

1) Participation is voluntary. Refusal to participate will involve no penalty or loss of benefits to which you would otherwise be entitled, and you may discontinue participation at any time without penalty or loss of benefits to which you otherwise would be entitled.
2) A risk of this interview is that you will be asked to recall situations which may be classified or sensitive in nature. Please do not disclose the exact name of locations, date, or time of any situation that your chain of command classified as secret.
3) This research will assist the program office in identifying areas that will improve the quality of the training material and course. This will ensure that operators are better prepared to maximize the performance of the SBS.
4) There are no other alternatives for collecting this information, the only options are to participate or not participate.
5) The requirements for participation include the following:
    - Volunteer to participate.
    - Read the consent form.
    - Answer to the best of your abilities.

– Approximately 15-60 participants will be interviewed.
– Responses will be audio recorded.
– Answer to the questions will only be used for the purposes of this research and serve no other purpose.
– Only demographic data and the answers provided will be maintained. Only research team members and the principal investigator will have access to the information collected.
– Research is low risk and not medical treatment is needed.
– The interviewee retains the right to pause or terminate the interview at any point during the process. There are no consequences for terminating an interview.
– If an interview is terminated by the participant, the following procedure will be followed:
    - Recording device will be stopped immediately
    - The participant will be informed that all responses given prior to termination cannot be deleted and will be stored with the rest of the data collected.
    - The participant will be excused from the interview room and released back to the unit.
    - The research team will annotate the reason for termination on the written record of the interview and the point in the recording device
    - Terminated interview data will be labeled and separated from completed interview data.

The interview/survey/experiment will take place in an interview room if conducted in person and via VTC if DoD travel restrictions prevent in person interviews.

Cost. There is no cost to participate in this research study.

Compensation for Participation. No tangible compensation will be given.

Confidentiality & Privacy Act. Any information that is obtained during this study will be kept confidential to the full extent permitted by law. All efforts, within reason, will be made to keep your personal information in your research record confidential but total confidentiality cannot be guaranteed.

Demographic data and recorded answers will be kept in a secure server and locked in an office. Only the research team and the principal investigator (PI) will have access to the data. The PI will maintain data upon completion of research. (At completion all data must and will be de-identified and stored by the PI. It may be stored in the PI's locked office or on the NPS secure server. No data may be destroyed.) DON requires all data, research notes, and consent forms be kept for 10 years before forwarding to a federal record center. However, it is possible that the researcher may be required to divulge information obtained in the course of this research to the subject's chain of command or other legal body. The type of information that may be divulged includes:

-Information about a situation LOAC was violated.
-Information about a mission which violated ROE.
-Information determined to be sensitive or classified in nature.

Participant's information collected as part of the research, even if identifiers are removed, will not be used or distributed for future research studies.

If you consent to be identified by name in this study, any reference to or quote by you will be published in the final research finding only after your review and approval. If you do not agree, then you will be identified broadly by discipline and/or rank, (for example, "fire chief").

☐ I consent to be identified by name in this research study.

☐ I do not consent to be identified by name in this research study.

Points of Contact. If you have any questions or comments about the research, or you experience an injury or have questions about any discomforts that you experience while taking part in this study please contact the Principal Investigator, Dr. Larry Shattuck, 831-656-2473, lgshattu@nps.edu. Questions about your rights as a research subject or any other concerns may be addressed to the Navy Postgraduate School IRB Vice Chair, Mr. Bryan Hudgens, 831-656-2039, bryan.hudgens@nps.edu.

Statement of Consent. I have read the information provided above. I have been given the opportunity to ask questions and all the questions have been answered to my satisfaction. I have been provided a copy of this form for my records and I agree to participate in this study. I understand that by agreeing to participate in this research and signing this form, I do not waive any of my legal rights.

☐ I consent to participate in the research study.

☐ I do not consent to participate in the research study.

Interview #: 1 SCN: AAHS-RDR-PR-20-146
Unit:1st BCT, 82nd ABN DIV Agency ID: SFAE-SDR-SMPT-SMS

Demographics

1. What is your MOS?

Response: I'm a 150U which is a UAS operations technician

2. What position were you serving in while using the SBS system (e.g., RTO or rifleman)?

Response: The brigade UAS operations officer

3. What type of platoon/unit were you assigned to while using the SBS?

Response: HHC, ADAM BAE

4. What is your current rank?

Response: CW4

5. How long have you been in the military?

Response: Almost 17 years

6. How long has it been since you last used the SBS system either in training or mission?

Response: A month ago.

7. Do you have experience with commercial drones or flight simulator games?

Response: Flight simulator games yes, I used to play them back when I was in high school, but it was definitely not like a drone simulator game. You're talking about around the turn of the century. Commercial drones? I don't think I ever really used them aside from like the small ones that you find in the middle of the mall in a kiosk.

Training

8. Tell me about the initial SBS qualification training you received (NET/unit-led).

Response: I receive the new equipment training that's provided by PM Soldier Sensor Laser. It was a 2-day POI consisting of academic training, simulator training and live flight training
P1: Can you expand on that a bit; how confident did you feel with the training you received?
A1: I'll go back to the fact that the academic training was also hands-on training. They had one system per two students and was for ideal for them and I do agree with that because that allowed for each student to be paired up on a system and able to navigate through the system menus and do some simple actions while the instructor was providing that block of instruction. Getting the hands-on training while receiving verbal instruction is always good when it comes to fundamentals of instruction, as they always try to train multiple senses at a time. It was visual, it was auditory, and it was also tactile, and that did help a lot. The simulator was used very briefly, and the primary purpose of the simulator was not to go through some of the advanced flight instructions such as building a route and setting up actions at waypoints, but more so just the basics of flying aircraft. How to ascend and descend, how to go forward, back, left, right, slide, hover. It was maybe 5 minutes on a simulator while the instructor was talking me

through the maneuvers and giving me tasks to accomplish such as flying up to a container that was in the simulator, hovering in front of some text on the container and reading the text. We also navigated through a course that he had outlined which is a route around what you would probably consider a container yard. Then after that we did GPS denied operations inside of the building that the class was being administered and they set up a series of obstacles from tables and privacy walls, that either required us to go under tables, around privacy walls, over privacy walls and look down to take a photo of a box that had some Cheeto trash in it and then fly it back. That allowed for us to experience GPS denied operations, fly around using the payload while not being heads up. Heads up being when you're looking at the A/V while it flies around, it's more so looking at what the camera is looking at, the payload feed, in order to navigate through obstacles taking photos, which is important for PID. That was the first day and the second day was outdoor instruction. I will say that because the cadre dropped from five to four which increased the ratio from 4 to 1, which is optimum, to 5 to one. I got less time on it. We constructed a route, we navigated around and took photos, and made waypoints. I should also say that during day one they went through the process of setting up waypoints and making a route as a prelude to the following day in which we would fly it.

P2: Did the higher student to instructor ratio impact the hands-on portion of the training?

A2: We just got less time on the system. There's two things that impacted our training, one the student to instructor ratio fell out of optimum 4 to 1 and also Kuwait midday gets really windy and at one point we just had to cut flight operations early because winds were kicking up The biggest one was honestly the wind because we were done by noon on the second day. More time was required to get additional hands on time and more confidence with the system.

P3: On a scale from 1-10 (10 being the highest confidence) how confident did you feel with executing the learned tasks?

A3: I'd say between 7 and 8. Because with any initial training that you get it truly takes repetition in order for the training to sink in and there just was not that much time afforded to do repetition.

P4: What would you do to improve the training?

A4: We did have a weather backup day, but the NET team was going to be out there for a set period of time, and I could set up the classes to be two days with the weather back up for each. The NET team was going to be there 6 or 7 days, so I could do two classes with the weather back up day and the output would be 40 trained operators. What I decided to do set up three classes at two days each added a 7th day that was going to be the weather back up day. If either class had a weather day, it would essentially slide the other classes back one. If there were two weather days, then the third class would not have been training. I gave up some of the training in order to increase the throughput. Optimally what you really want to do is you'd want to have a weather back up day that's planned in there to afford opportunity do conduct flight training if weather impacts one of your primary days.

9. Do you believe the SBS simulator is useful, and, if so, describe how did it improve your understanding?

Response: The simulator is a sustain. It runs off a USB drive and then it has a hand controller that's the same as the hand controllers used with the system and it just has a

USB adapter. This allows you to get plugged into a laptop. The problem is the USB cannot be plugged into a government computer what they truly need to do is figure out how to bridge the gap in order to get the simulator to work on a government computer. Because it's also a computer program, it might be a 2-fold issue, it could be the USB is issue number one and then issue number 2 is getting the program file on which to run. If it's just the USB, then they probably need to provide Blue Ray players because I'm certain Blu Ray players should have the data required for the program. The next bridge would be whether you can get that program to run on a government computer. As it stands you must use a personal laptop in order to use the simulator and that needs to get fixed.

P1: Would the simulator work on a standalone computer?

A1: It would work on a standalone computer, but it needs to be Windows 10. I had the Raven and Puma laptops available and we attempted to use the CF-19 Panasonic Tough-books with the stimulator, but it was not compatible because it was running off of Windows 7. like for my section we have a standalone computer, I think it's made by Alienware, it's our Aviation Mission Planning System. You can use external thumb drives or hard drives with it so simulator would work on that standalone system however I don't believe companies within the BCT have any standalone computers. Each battalion S2 should have one so they might be able to use that one, but I think there's only so much the S2 is going to be willing to risk when providing laptops to 11Bs.

P2: What is the most important thing you have learned using the simulator that transferred into your training or operational employment of the SBS?

A2: I value the simulator. I have three of them for the brigade and I advertise them as much as I can because use of the simulator allows them to fine-tune their flying skills and hopefully prevent them from crashing PD-100 in real life. Additionally, the stimulator should be in the tablet. That would circumnavigate the requirement for a computer. That is my advice for the simulator. More people will be willing to self-teach if the simulator was easier to access.

10. After you were initially trained on the SBS system, did the unit ever schedule sustainment training on the equipment (i.e., platoon training, sergeant time training, individual Soldier proficiency)?

Response: Some of the companies did do training, if they went to the range, they would try to fly their SBS. I know one of the battalions has done SBS training. Another battalion conducted qualification training using a two-day program of instruction that I created based off of the NET training. What they typically do is pair their SBS training with their small-UAS training. I have a small UAS currency week at the end of the month. 28 September to 2 October and in the order, I tell the battalions to send their SBS operators. Typically, about 50 to 60% of the population shows for small UAS training.

P1: Did that training you coordinated help the battalions develop their own training?

A2: Yes, some battalions have incorporated that into their training.

P3: What recommendations would you have for battalion sustainment training?

A3: I wouldn't glorify it, it's still a struggle. I mean essentially what I must do is I have to reach beyond what should be my level of control and I contact operators directly. I don't maintain that same level of contact with SBS operators just because the SBS is

less regulated than small UAS with reference to AR95-1 Appendix D for a small UAS and Appendix E for SBS and then TC3-04 .62 for small UAS program management.
P4: Is there anything that has restricted your ability to conduct sustainment training?
A4: Working with range control. PD-100 do not require a ROZ. Because of the congested airspace here at Fort Bragg, range control requires the SBS to fly within a ROZ. I spoke to range control yesterday about deregulating it in order to make it easier for operators to use. Right now, the biggest deterrence from training is going to be the range request process. We will never get rid of this requirement but what we can do to make it easier is to come up with procedures that will enable training. The more red tape that you put around the procedures to fly the SBS, units are not going to fly it and if they do fly it they're not flying it to the standard required to keep it safe in the airspace. Units will just throw it up in the air. If it was easier to arrange training, then the units would use it more. if you want to enable more training to make it easier for them to train do.
P5: Do you think range controls knows how small the SBS?
A5: I think it's just a growing pain. Fort Bragg is going to have all the airspace users adjust procedures to enable SBS. SBS, in my opinion, is the way the future for the ground soldier. If you don't accommodate that training it's only going to result in insufficient training, the potential that could result in lost lives because they did not use the SBS. If they had the training, units would employ the SBS and it could save lives. We just must get everyone together on the same page and try to make it easier It's just a growing pain that needs to occur within the Army in order to incorporate SBS into the airspace. Each area needs to incorporate the SBS into their airspace. JRTC has done a really good job with it.

11. Did you use the SBS during your CTC rotations or field training exercises?

Response: We have not had a CTC rotation since we were fielded the SBS.
P1: You mentioned JRTC has a good process in place for the SBS, how are they doing that?
A1: They mandate that SBS operate below the highest obstacle right, if the training unit is around trees, they cannot fly the SBS above the trees; if they are close to buildings, they can't fly the SBS above the highest building. They created a vertical limit that prevents helicopters from flying into it. Aircraft are not going to fly below the tree line and they're not going to operate below the top of buildings and if they do, the probability of there being an SBS in that area is small. The PD 100 is going to do very minimal impact. I have flown a helicopter into a flock of finches and hit about 6 of them and the PD-100 is like a finch. I don't know what it does to AH-64, UH-60 or CH-47 engines because they're inlet is exposed but they run the same risk flying around birds.

12. Describe the biggest maintenance problem for the SBS?

Response: The biggest issue with maintenance is going to be the logistical support for the SBS. We are going to have issues with getting parts.
P1: Was there a time you had to adjust the way you employed the system for fear of not being able to replace non-serviceable parts?
A1: No, the only thing that I've done to avoid maintenance issues is encourage the use of a simulator prior to live-flights. This will reduce human error due to a lack of proficiency. It will also reduce the possibility of either crashing, damaging, or losing the SBS. A PD 100 itself is $8000, the system itself is $30,000, main rotor blades are

$800, tail rotor blades are $500. It is a lot of money and unlike the Shadow, the Raven, and the Puma, purchasing repair parts for the SBS goes through unit funds. If a unit loses an A/V and it's $8000 to replace and they also have a HMMWV that has a blown transmission and it cost $8500, which do you think the unit is going to place higher in priority? Fortunately, with the fielding, they gave me spare parts and I've been holding them at brigade level. Some companies will use the SBS more than others and I allocate spare parts based on that. I've kept some parts in order to make them more available to companies that want to get out there and fly. Also, SBS parts should be expendable so if soldier's break a part they will not be subject to a statement of charges. I don't think the average user will go into the manual and teach themselves for fear of damaging or destroying the SBS and be subject to a FLIPL.

Equipment Documentation (TM, Operating Manual, SOPs)

13. How did the Operator's Manual assist with operations and provide an example?

Response: The Army TM is still in draft form. I haven't checked APD recently for it, I think I checked 2 or 3 months ago, and it was still not published to APD. There is a commercial/ manufacturers operators manual and a quick start guide. Both of those are usable but they're only usable to a certain point because there are no NSNs listed. Fortunately, I have the draft TM that was given to me by the fielding team. The commercial operator's manual is decent, it contains the basics, soldiers will never look at it, they will look at the quick start guide. However, the SBS is designed to be self-taught, so there should be some type of class included with the system. AR 95-1 says no formal training required, the SBS can be self-taught. Even though the operator's manual will allow someone to teach themselves, there should be a class included aside from NET initial training. What did you most commonly use the manual for? (basic functions, PMCS...)

14. What did you most commonly use the manual for? (basic functions, PMCS...)

Response: [answered above]

15. At the team, squad, platoon, or company level did you develop any additional SOPs, smart cards, training aid, etc. for the SBS?

Response: I developed an SOP in which I mandate that if they are in a training environment, they have to adhere to a 2-day program of instruction which includes academic instruction and the use of the simulator. But I do not put dictate training while in a combat environment. In combat it is the unit's responsibility to ensure proficiency.

P1: Did you distribute the SOP to the battalions?

A1: I gave the POI to the battalions. I had the SOP signed in July, however some publications that were references for the SOP have changed, so I must adjust the SOP before I can distribute it. The POI is only for the training environment. I can send any of these documents your way.

16. Based on the many uses of the SBS have you included it into existing battle drills, TTPs, or SOPs? If yes, please describe.

Response: [answered above]

17. Have you participated in any currency training as a dedicated SBS operator?

Response: There is no regulatory requirement to conduct currency training on the SBS. I have a tracker that I use for small-UAS and I have incorporated SBS users into that tracker. I have recommended that the SBS be flown every 180 days and I recommend using the simulator prior to any training exercises that will include SBS usage. When I conduct small-UAS currency training events I invite SBS operators. I know some of the battalions have done currency training and they usually pair it with another event.

P1: In your POI, do you have evaluation criteria?

A1: I have not done that primarily because once you start doing that, you're starting to create an aircrew training program. It makes complete sense but at the brigade level, I don't want to open up that can of worms by managing the battalion's training program because at that point in time I have to provide some type of oversight. I don't think the brigade should really have to worry about that. The POI has a culminating practical exercise that has objective grading criteria for grading the operator. With the SBS there is no instructor pilot equivalent, there are no SBS master trainers and I hope they never create them, because it would be able to just go nightmare for TRADOC to produce enough for the army.

P2: In your practical exercise, what was your evaluation levels?

A2: I was SAT or UNSAT and RETEST. The units will conduct immediate remedial training and re-tests.

18. Is there anything you would add to the operator's manual or the SOP and what specifically would include?

Response: I would just say that when you start talking about training of people on aviation assets whether it be manned aviation or UAS, including small UAS, there has to be USAACE approved POI. For example, the Raven, there is a team that goes around and does initial qualification for the Raven and the Puma. They have classes that are approved by the United States Army Aviation Center of Excellence. There must be someone out there that develops a program of instruction that is the standard for the SBS. I think MANCOE should develop a training program of instruction standard. Right now, there is no standard, training varies between units.

SBS Employment

19. What was the nature of your unit's mission (route clearance, armed escort, patrol)?

Response: It could be used to gather intelligence right before hitting a target. I consider the SBS as a force multiplier when units are conducting actions on the objective. When they are about to hit a house, they fly it up and see what is on top of the house or if they're about to go into a house, before they enter the house, they send the SBS in the house. The SBS is a sensor used to increased situational awareness of the user at the squad level. Its squad-level information that can be turned into intelligence.

20. Was the SBS included in mission planning, if so, how? (explain what mission planning is if you feel it necessary)

Response: I would hope so. I will get better fidelity on that as soon as we do a brigade culminating exercise. In October we're doing company evaluations. I've developed a

couple ROZs with the intent of the SBS being used for it. If the ROZs are getting used a lot then I think that's a good indicator that squads are training on the SBS.
P1: Do you know if the BNs have used it in training missions?
A1: I do not know. I know that companies have been using the SBS, but I do not know if the SBS is worked into the scheme of maneuver.

21. What types of missions did you most use the SBS for? (base defense, TCP, route clearance...)

Response: [answered above]

22. Describe a mission that was successful because of the SBS?

Response: [answered above]

23. Can you think of a time when the SBS hindered a mission? (delayed a mission, stopped a mission, put personnel at risk)

Response: I fear that because this stuff is purchased with unit funds finding it will take priority. For example, a unit out on mission loses the SBS and they choose to go find it, and that results in a fatality. If we do not make the system truly expendable, then I fear a life will be lost trying to retrieve it. I only say that because I recently talked to a first Sergeant hates Ravens his unit lost a Raven in Baghdad and one of his soldiers was killed trying to retrieve it. If that were to happen over the PD-100 that would break my heart.
P1: Is the payload resolution sufficient to conduct recon activities on an objective?
A1: The resolution needs to be better. The IR one is pretty much useless unless you're flying on top of whatever you're looking at. The resolution does need to improve, but what the resolution is currently is better than not having anything; however, current resolution makes it difficult make out details.

24. Did you use the system the way you were taught during initial qualification or sustainment training?

Response: Yes

25. Think of a time you had to recover a downed SBS. Can you describe the event(s)?

Response: The PD-100 is prone to loss. The operators have been given techniques in which to use the system to try to find it. You can figure out the last grid coordinate the SBS was around and can go to that grid coordinate and look around. Also, using the GPS and the antenna the operator can get close to the SBS. The potential exists that the SBS going to get lost and it's gone the A/V itself is expendable

26. For a future SBS configuration would you prefer:

Response: The SBS needs to come with 3 A/Vs. It needs to have 2 EO (daytime), 1 IR (nighttime), it needs to have the external antenna and the battery charging cable. We did not receive the external antenna and the battery charging cable.

27. Is there anything not covered in the interview that you would like to expand on at this time?

Response: At a minimum the SBS should include the battery charging cable which would allow companies to recharge their system with the ASIP battery. We didn't even get fielded the system, it's a loan to the government. I spoke with PM Soldier Sensor and Laser and was told that we would not get the external antenna or battery charging

cable. This is important for infantry companies because they do not have access to A/C power when they are out in the field. What I did learn is that the Raven and Puma have line cables that you can use to charge the base station. But this is not a good solution because the cables do not lock in place. PM SSL needs to go back to the units that were fielded the system and they need to give them that charging cable. They need to do the logistics for the SBS the exact same way that they're doing with the Raven. They need to manage that pot of money at the PM level and units need to be able to reach out to the PM and do one-for-one exchange.

P1: You are saying that a direct point to point with the PM would greatly enhance sustainment operations?

A1: Absolutely, especially because these things cost way too much. Units will never prioritize this over rolling stock or pacing items. Companies are given 1 per squad they will do controlled substitutions to make complete SBS systems which will lead to more systems that are not serviceable.

To reiterate:1) Units need to be given a means to charge the system with no A/C power. 2) The simulator needs to be included in the table. 3) Standardization of training. 4) PM Soldier Sensor Lasers needs to own the pot of money so units can call in to request repair parts. If the item is a high dollar item, then they should be able to do a one for one exchange. 5)Better optics.

Questions Supportive of the Snowball Sampling Method

28. Is there anyone else who comes to mind you would consider as proficient with the SBS system who would be beneficial to talk to?

Response: SSG Ortiz. [we had already scheduled him]

29. Do you have their contact information?

Response: [already answered]

30. Can you ask them if it is ok if we contact them?

Response: [already answered]

Interview #: 2 SCN: AAHS-RDR-PR-20-146
Unit: 1st BCT, 82nd ABN DIV Agency ID: SFAE-SDR-SMPT-SMS

Demographics

1. What is your MOS?

Response: So, I'm at 35F all source intelligence right now with first brigade combat team [82nd Airborne Division] here in FORSCOM.

2. What position were you serving in while using the SBS system (e.g., RTO or rifleman)?

Response: I'm the Cavalry Reconnaissance Squadron S2 NCOIC for the past years with a team of 7 personnel and 400 paratroopers under Squadron right now. Yeah, so we have some capabilities that go from Pumas, Ravens, and now the PD-100s (Black Hornets) and obviously all the other reconnaissance assets that we have available to us.

3. What type of platoon/unit were you assigned to while using the SBS?

Response: Cavalry Reconnaissance Squadron

4. What is your current rank?

Response: SSG

5. How long have you been in the military?

Response: I've been in the Army for five years all of them in first brigade, 82nd

6. How long has it been since you last used the SBS system either in training or mission?

Response: I used it last night up during night operations. Earlier, we are currently in the field, so we did two flights at night.

7. Do you have experience with commercial drones or flight simulator games?

Response: No, not at all.

Training

8. Tell me about the initial SBS qualification training you received (NET/unit-led).

Response: When we were first fielded the SBS. We got the personnel from Fort Bragg [the NET instructors] to train us and directly in Kuwait, we were deployed at the time. It was a five-day course, but they shortened up to two days. We flew only day. We didn't fly at night during that training. First day was completed in the classroom. Then the second day we flew all day during the day. No night flights during that qualification training. Additionally, we sent paratroopers in Kuwait to train with personnel stationed in Kuwait. They did a five-day course of the SBS and they flew at night; that was five days of training.
P1: Where did you say that was in Kuwait where they did that five-day training?
A1: Camp Behring.
P2: Did you guys get a chance to use the simulator at all during your NET?
A2: No, we didn't use it during that NET training. But, obviously, since I'm one of the master trainers that trained people then I used it during that time to train personnel. The people that went to the five-day training course, they did the simulator. Now, the other thing is in the past was that it was so short and there were so many people, they

had the simulator there, but it was demonstrated; it was a more hands-on. But the POI they gave to us you actually have to have hands on the simulator.
P3: To confirm, they showed you the simulator but didn't let you guys use it; however, the next group that went through used it?
A3: Yes, the next group used it. We had the whole brigade we have like five or six group that went through. Since I'm the master trainer, I was one of the first ones. The other teams, I know because I was there, they have a little bit more hands-on on the system, on the simulator, itself.
P4: You mentioned that kind of interesting thing about how you guys didn't get to fly at night so I'm assuming that's an improve. Are there any other improves you might have about the NET qualification course?
A4: Yes, I think that it should be mandatory to fly it at night because the reality is that a PIR [Parachute Infantry Regiment], an infantry battalion, an infantry scout, a scout, people will not be operating this asset during the day. Usually, the operational time for ground troops is a night so, yes, it is imperative that we train these personnel, this paratroopers in my case, to fly it at night and be able to identify targets during the night.
P5: Did every student in the class at least get to fly hands-on flight training whether it was day, night, or both?
A5: Yes, everyone flew. So, how I did it was divided two people per SBS system and that way we can rotate through. One can fly and then what we did is we would switch batteries so we can have more flight time.
P6: As you went through the NET, on a scale of 1 to 10, how confident would you say you were just after you left that short NET course?
A6: I will say like an 8 because they/we went through like flying without GPS, GPS denied, and all that; we went through everything. The only problem is the night portion of it; that's the one we didn't do. But everything else we did it. I think what they did was perfect to build that base that the operator needs to go out and fly. Now, it's obviously on the unit now to build that proficiency. Yes, it's good what they did, but that put a little bit more pressure on the unit to build more proficiency. You have to make sure to go out and fly at night and sometimes we don't have the time to say hey you know what I'm going to send 5 operators randomly to go out at night and fly. Usually when they first go fly at night is when they're like on the mission. It's a little bit tricky for them to be able to complete their mission plus at the same time learning for the first time how to fly at night.

9. Do you believe the SBS simulator is useful, and, if so, describe how did it improve your understanding?

Response: Right now, all the operators prior to this field problem, all of them did the simulator. The problem is we only had three of them for the whole brigade. Granted, we don't have a lot of master trainers so it's easy to control them; I can go pull one quick.
P1: How often would you say you get most of your operators on the simulator; how frequently do you require them to use the simulator?
A1: We are mirroring the Raven and Puma POI [Program of Instruction] in the sense that the operators need to do a simulator every 30 days. In this case because it's just SBS we're not requiring every 30 days; regulation doesn't state anything. We are doing it every 180 days and we're forcing them to fly and do the simulator prior to going out

and flying. So, we don't let him fly without doing simulator. At least that's me at the squadron-level because I can control the whole squadron personnel. For brigade it is a little bit harder because not every battalion has them. I'm pretty sure I can assume that other battalions are not doing it and they're just going out and fly directly without the simulator at all.

P2: Is there anything you would like to see improve with the simulator to help train your guys better or you know something you really wanted to train but you couldn't just because of the limitations of simulator?

A2: I like the simulator. I think the only limitation is I can't use it in a government computer. I have to put it in a personal computer and the reality is like me personally if I don't put it on my computer then I can't force no one to bring their computer so that's what is limiting us right now. If the system we can manage to get approval by the Army to use on the NIPR, on an unclassified system, that will be a game changer and then we can have more people going through the simulator. But right now, we are limited to 3 for a whole brigade and you are forced to use a personal computer.

10. After you were initially trained on the SBS system, did the unit ever schedule sustainment training on the equipment (i.e., platoon training, sergeant time training, individual Soldier proficiency)?

Response: Right now, we're in gunnery. We are going to transition to three weeks in the field. We are doing gunnery right now but then after this we're going to jump. We will have all paratroopers jumping the system and that jump will transition to the STX [Situational Training Exercise]; so that's when the troops are going to be collecting and trying to find an enemy on the ground. We have an actual OPORD [Operations Order] that is going to be supporting our training. Like I say after all of this, I can email you what happened how it went down so you got that feedback from us.

P1: It sounds like that Charlie troop is really you know you got your two hours of battery life and you're out of luck is that true?

A1: Yep, that's true.

P2: Is there anything else that has restricted your ability to use the SBS during your unit-level sustainment training?

A2: I will say, propellors for the equipment-wise, it's a little bit expensive. We usually have operators that are extremely careful with it. We're not pushing it to limit, we don't push them hard like we do with the Pumas and Ravens (we push them hard), but I think it's just too because we are all new operators on this system basically have them not even a year right now. But that is part of a limitation on our because if it breaks, we don't have parts to replace it.

11. Did you use the SBS during your CTC rotations or field training exercises?

Response: [gunnery and reconnaissance as described elsewhere]

12. Describe the biggest maintenance problem for the SBS?

Response: I say the two propellers are the biggest issue right there. Those two propellers, they break quickly, too fast I will say. You can hit them with something like in an instant, and it will break and then you don't have that capability completely. I say other than that everything is perfect for now. Like I said, the systems are new, so they haven't given any problem. Maybe if you guys do this a year or so after this, we will probably have additional information, but for right now with them being new, that it –

the two propellers. So, I think uh the only problem I see with this SBS is the battery life and the range.

P1: Have you had issues getting new propellers in or getting re-supplied or reordering parts as needed?

A1: Right now, no, because we are doing it through one-person, Chief Leach, the other master trainer. I don't know how it's going to continue after he leaves; so, I don't know the process. I was going to say after that, it should be maintained at brigade. Who's going to be doing it? I don't know.

P2: Have you guys done anything to modify the way you use this system to protect those propellers or have found any creative ways to employ the system to ensure you don't break anymore propellers?

A2: The problem is, for example here gunnery is open, but the problem is that the reality is that our missions are done within the wood lines. We're inside the woods so this is the operating terrain at Fort Bragg. The operator does not have too much room to wiggle around. If you go up, you will hit the trees in the top and if you are not paying attention to the trees around you are going to hit it. It's a hassle anyway, but it's going to break. You're going to hit something here. Right now, which is the last one that used those this time we already broke two systems propellers. I'm waiting on the other two so how they see how they come back but haven't seen them breaking anything so far. Like I said, we're doing gunnery so it's in the open there's nothing that can hit that air vehicle. But that's not the reality of our operation. After the FTX/STX, I will have more feedback. I'm pretty sure they're going to break more systems. We will break them all in training – it will happen!

P3: Just to confirm, you guys have had issues getting parts though or you just foresee that will become an issue.?

A3: No, I'm not having a problem getting parts, I'm just throwing that out there as an idea because there's so many of these systems that are going be here. First brigade we have a lot of them. Second brigade are going to have them too, at some point, I'm assuming. It's a lot of systems at one place.

Equipment Documentation (TM, Operating Manual, SOPs)

13. How did the Operator's Manual assist with operations and provide an example?

Response: I don't use it; that's the reality. I took the class and I always keep in the same class through PowerPoint so basically it does that's what I have and anyway when I read the manual is the same class in PowerPoint that we have. It's basically the same thing I will have, and we don't give the system manual to new operators. I figured out how so we basically getting the full class. The operator manual is more there for a reference point for you if you don't have the slide show. We have the operation manual in the system so if we need something, we will go back to it. That's how we use the operator manual.

P1: Have you ever encountered a situation where you're like "man I don't know the answer to this question" and you go to look it up, but you didn't find it in the operator's manual?

A1: I know everything that we had look for is straightforward. I'll say a little bit I haven't been able to do is connecting to the Internet. I will be able to do it, I don't know I think it should be more explanatory the operator manual. When you connect to the

Internet to download those Maps. All our systems are without Maps just because that – we haven't even figured out yet.
P2: Based on your response, as the Army works on distributing a TM, it sounds like maintaining the Maps is a big thing that you would kind of like to see some help on?
A2: Yeah, and another thing, I don't know if we can do it in the system, but I haven't found it in the manual, for example we have we have the means to pull video feed understand the SBS is a frequency hop it will be jumping between 2, 4, 6, and 8 frequencies to evade detection but then I don't know if there's a way I can see them in the manual up to me to fix that video link and pull it through my OSRVT [One System Remote Video Terminal]. We haven't been able to do that. The reality is at the end of the day is that you want that commander to see that video feed and understand what is happening out there. He wants to see what the most forward scout is looking at and so he can execute and make the decision. Right now, the only person to have access to that benefit is the operator.

14. What did you most commonly use the manual for? (basic functions, PMCS...)

Response: [Respondent does not use the Operator's manual, only the training course slides]

15. At the team, squad, platoon, or company level did you develop any additional SOPs, smart cards, training aid, etc. for the SBS?

Response: Well, I was the one helped Chief Lee write that one, so basically, they want a standard for the whole brigade. I didn't want to deviate from that one since this new system was trying to figure out first, so but I expect that in the future there will be an SOP for squadron. Right now, we're rolling with that through the whole brigade like I said we only three master trainers in the whole brigade that can manage everything. If we get more people, that should evolve, and we should have an SOP in every battalion.

16. Based on the many uses of the SBS have you included it into existing battle drills, TTPs, or SOPs? If yes, please describe.

Response: I'll say no. During a convoy operation it's going to be hard because of the speed. The reality is that this SBS is not done for convoy operations. I will say it will be utilized more in an OP [Observation Post] location and then I'm going to deploy the system if we're doing an STX. For convoys, we have other assets that we can employ that are more built for that type of operations like the Puma or the Raven; we use them for that. We left the SBS and SBS video feed that SSG [squad leader] will employ that system at his level.

17. Have you participated in any currency training as a dedicated SBS operator?

Response: Based on what I have seen, 180 days is a lot of time. We should cut that down to 60 days – that's the reality. We should do the same with the Raven and Puma in 60 days, but we're not allowed by regulation. We must do every 30 days. But SBS-wise, every 60 days an operator will maintain a confidence on the system, he will be proficient, and he will be able to conduct his commander's intent with 60 days. It will change in the Brigade SOP, if not, when we create our Squadron SOP, we will include it there because 180 it is too much. Since we only have 3 simulators per brigade, the reality is they're not going to be doing simulators every month.

18. Is there anything you would add to the operator's manual or the SOP and what specifically would include?

Response: The regulations state that this is a system that doesn't need training at all. You go to AR 95-1; it says that I can literally take the system and give it to a new paratrooper and go out flying. We don't do it like that here we have a recipe we build it that way we maintain proficiency of operators, but I don't know if other units will do it like that. So that's one of the things that we implemented here in first brigade, that SOP.

SBS Employment

19. What was the nature of your unit's mission (route clearance, armed escort, patrol)?

Response: It [the SBS] is great because we are a reconnaissance squadron and that's a recon asset. We are using it and exploiting that capability

20. Was the SBS included in mission planning, if so, how? (explain what mission planning is if you feel it necessary)

Response: At my level I don't plan or force them to use them because the Staff Sergeant or squad leader is the owner of the system. What I do is I provide them like hey, you should use the system here this operation. I'm not going directly and tell a troop commander to force him to use the SBS. What it should be is your training your staff Sergeant or squad leaders on that capability and that's what we do at my level as far and I take my squad leaders and hey this is the new capability you have; this is how it's going to work for you, this is how it's going to allow you to save the life of your guys, and at the same time see the target. This you can use at the same time to see additional targets if you're not going to be able to cover with personnel. Usually, you don't have full manning so hey why wouldn't you use this system that you have to cover that gap in personnel that you have right now. Employed it, watch that NAI [Named Area of Interest], and have that report come back. that's how we've being employing it just uh we're empowering our squad leaders to use the system.

P1: Have you seen any unique ways they integrated it into mission planning? For example, you were sitting in a company brief and just said man that's interesting they included the SBS in the mission planning or not?

A1: The only time I saw it is here during gunnery. In the live fire, one of the squad leaders put an additional operator in his truck, a fourth person to operate the system and to help them acquire targets. That's the only thing I have seen so far. I will have to go down to them and pay attention to how they're doing it.

21. What types of missions did you most use the SBS for? (base defense, TCP, route clearance...)

Response: Response: I'm going to give you a great example that is right now. Right now, we're doing gunnery. So, we have our mounted troops put an additional body in their vehicles that is just an SBS operator. We're using the SBS to acquire target downrange and have that 50 Cal gunner/MK19 gunner shoot at the target. That's how we implemented it right now. it's the first time we do it, so I haven't received any feedback from the command team about how this has improved the target. But we're going to finish gunnery on the 19th so I probably should email you the feedback and how if we improve on our targeting or we don't improve. That is how we're using the SBS now. Additionally, uh we been using them to identify targets, stationary targets.

Obviously, we do it with ourselves, but it's been money for us. For example, we flew over areas and identify the type of ammunition we have, we identify amount of personnel, we identified vehicles, we identify names of personnel, we have identified all weapons system that the trucks have at that point, we have identified complete support troops with fuel tanks mechanics, we have identified all those areas.
Response #2: No, I haven't. The FTX, we haven't planned for yet. I haven't seen the troops plans for that yet, and so that will come in a couple of days. I will have more injections on that and more to follow on that part.
P1: Is there any kind of training your unit does that you really want to integrate the SBS into as you go forward that you might not have been able to yet?
A1: No, we had done it for everything I don't know the PIR when the infantry guys from the other battalions when they do breach and clearing compounds I don't know if they're actually using them. In our case we don't do that. I don't have a need right now for my operators to fly for example GPS denied inside a building because that's not our mission. We're just observers. It's perfect for us because we observe; we identify the target and then we action the target if we can. If not, we will pass it on to the brigade to action that target. So right now, for us it's a perfect system for the short-range capability that it brings.

22. Describe a mission that was successful because of the SBS?

Response: In the gunnery table, the SBS in the trucks acquiring target and directing the gunner. Like I said we have a 50 caliber and MK-19 with gunners and [SBS] operators in their respective trucks. When they came back the reaction was that 1 of the trucks have an experienced [SBS] operator so they were moving faster in acquiring targets. The other one had an inexperienced [SBS]operator and they ended up bringing the system up and terminated the operators flight times so they can continue the gunnery. The problem is proficiency; that is what it comes to at the end of the day. Proficiency. How proficient are my operators to conduct missions? If they are proficient enough, it is going to be successful, they are going to acquire the target. The SBS operator is going to help that gunner acquire that target and hit it with more accuracy. And it happened with the first one—the one with the more proficient operator.
P1: Is that operator in the truck up on comms relaying the distance and direction to the target or do you know how he was relaying that information he saw on the screen?
A1: They're both together right by each other in the HMMWV [gun truck]. It is just basically screaming to him, "hey man like shoot lower, shoot higher, a little bit to the left a little bit center." That is basically how they did it.

23. Can you think of a time when the SBS hindered a mission? (delayed a mission, stopped a mission, put personnel at risk)

Response: Every time I have heard something back it's because the operators were inexperienced, and they break the system. They are going hit something and they're going to hit a wall or a tree. That happens during training, but it is training where we do not have the means to bring a simulator to the field but yes, they must train. That is the reality of it. The SBS's range is the one that is holding us back because we didn't get the external antenna. I got another limitation too. We did not get the field charger to be able to charge in the field we did not get that either. We have basically 3 hours of battery life. Personnel that are in the TOC that we can charge it, but troop-wise, troop-level, our Charlie troop, which is a dismounted troop, they don't have a vehicle to

charge that out and they don't have the capability to charge for a 55/2590 batteries so that will be a game changer for us especially our Charlie troop that is a dismounted and we usually pushing Charlie troop 30 clicks away from us, from the whole brigade.

24. Did you use the system the way you were taught during initial qualification or sustainment training?

Response: [Yes, answered earlier with no major modification]

25. Think of a time you had to recover a downed SBS. Can you describe the event(s)?

Response: We have not integrated that here, but during the initial qualification training we train them how to find a downed air vehicle. We train both ways the manual describes to find the air vehicle and that is what we're training them.

26. For a future SBS configuration would you prefer:

Response: I would maintain the two the configuration we have day and night, and I will provide additional batteries. If that's the case, that's what we must do to have additional missions I will add additional batteries, the external antenna, and the field charger. I think we could do with one extra battery, with the field charger for the GCS system, and the external antenna. Those three items that will be sufficient for the mission. I don't know what will be the process for parts like rotors, but with a base that big, like Fort Bragg, with so many systems – why don't we have a warehouse at Fort Bragg or something?

27. Is there anything not covered in the interview that you would like to expand on at this time?

Response: I think one of the things that are a shortfall on the system is the lack of the camera being a gimbal. The cameras are fixed to the front. I understand how small the system is and that it's hard to have a gimbal payload to do 360 [degree scan], but if you have that capability out there to be able to do a 360 [degree scan] close to the enemy, that would be perfect. The night SBS [Thermal Air vehicle], is a little bit tricky when you're flying it. But, in the range I have open terrain, its easy. I have tree lines where we operate so I do not know but I'm pretty sure it's going be super hard to maneuver there at the night with the night camera.

P1: Have you had any limitations where you really want to train but you couldn't because of whether it was like getting range control or airspace clearing, anything like that?

A1: So far no, because what we put in our SOP is that they can train for example we're doing it we are on the rear they can train with the SBS inside the building, but the limitation here [on the range] is then we need a ROZ [Restricted Operations Zone]. Fort Bragg requires us to request a ROZ. I don't understand, I disagree with that. Obviously, I do it, but I disagree because it's an SBS system; you will not fly over 100 feet AGL [Above Ground Level], basically you're below the treetops. I disagree for requesting a ROZ to use this system. I think it should be just going out and fly and the operator should understand from his initial training he will not fly over 100 feet. Granted, your operator is a 19-year-old kid or 17-year-old kid, so they see this system as a toy; however, it's an expensive one. They are going to go out and try to play with it as much as they can. But it depends on how you let them know the importance of staying under 100 feet AGL. Because something can happen to a micro [UAV] and you don't want that to happen because you don't want to be held responsible. I understand the purpose of the ROZ, but I don't think it's needed.

P2: Is there any last comments about SBS or the training program you'd want us to take back to the program to say this is really good or fix?
A2: I will emphasize more on the mission planning portion of it and it's not just building the mission in the system but the importance of building that mission [in relation to] what the end state [mission] is. The correlation is not there. We will put that in there because we are Raven and Puma operators, so we are used to that. The other improve is that it [the training] should have more pertaining with air [airspace] management. It doesn't have a lot of air [airspace] management classes so when you're asking this operator to not fly over 100 feet, they're like yeah, I understand I must be careful because I can cause damage to manned vehicles or possibly cause loss of life but that's it. It doesn't go more in there like the difference on air, the difference in ROZs, the difference of air vehicles, such as [UAS]Groups 1, 2, 3, 4, and 5. I think it should have an include a little bit more of that, so our operators are more aware of what's happening around it.
P3: You recommend more airspace management (ROZs), the different classes of UAVs, and how to build that stack or how it's layered and integrated with one another?
A3: Yes.
P4: Do you feel it is necessary to do a lot of recovery training or modify your training to account for all the trees in the very wooden environment or are you focusing on what to do if the SBS goes down?
A4: We haven't tailored our training to account for that. It's good advice now that you mention it. We can add a little bit more of that, but we have not. We just maintain what is in the POI, for example this is how you find it at first and that's it so far.

Questions Supportive of the Snowball Sampling Method

28. Is there anyone else who comes to mind you would consider as proficient with the SBS system who would be beneficial to talk to?

Response: Right now, no, uh unless you want me to bring one of the Staff Sergeants that used the system with to see these reactions to it and how we see it. uh oh well so far, no I don't have no one.

29. Do you have their contact information?

Response: [NONE]

30. Can you ask them if it is ok if we contact them?

Response: [NONE]

Interview #: 3 SCN: AAHS-RDR-PR-20-146
Unit: 2nd BN, 1st SFAB Agency ID: SFAE-SDR-SMPT-SMS

Demographics

1. What is your MOS?

Response: 11B

2. What position were you serving in while using the SBS system (e.g., RTO or rifleman)?

Response: So, I was HHC first Sergeant for the for-2nd BN, 1SFAB.

3. What type of platoon/unit were you assigned to while using the SBS?

Response: 18 years.

4. What is your current rank?

Response: Master Sergeant.

5. How long have you been in the military?

Response: 18 years.

6. How long has it been since you last used the SBS system either in training or mission?

Response: I want to say March or April maybe.

7. Do you have experience with commercial drones or flight simulator games?

Response: A couple commercial drones but mostly the military stuff. Raven, Puma, SBS. I've been able to fly a commercial quadcopter and it was kind of like a virtual reality goggle type of commercial drone.

Training

8. Tell me about the initial SBS qualification training you received (NET/unit-led).

Response: I think it was PEO Soldier that came down. They tried to get as many UAS master trainers certified to come to the class. I did not receive the training directly from PEO Soldier. So that's is one of my suggestions being a master trainer for the other systems that we have. Basically, once the once the guys got the training from PEO Soldier I asked how to use it. A very quick overview of the Handbook that comes with it and just kind of troubleshooting and then I taught myself how to use it during COVID-19 lock down. It was just the like the manual that comes with it like they have the quick reference guide but then you have the actual paper manual that came inside the kit. I think the people who went to the class it might have been weeklong. Like an hour is like hey here's the here's the system is how you turn it on as I fly and then the rest of it was just me being familiar with terminology. It's a lot of similar terms I guess in a lot of similar functions as other systems that we use so it was easy to pick up but yeah it wasn't like a formal classroom portion for me. I think if it hadn't been for my prior experience in like flying so many different pieces of equipment. I wouldn't have been able to fly it with the short little hour class that I got on it. I wouldn't even call it a class it was more of like a familiarization

9. Do you believe the SBS simulator is useful, and, if so, describe how did it improve your understanding?

Response: No. If it was me, I would incorporate that into my training just like we do with the Raven and the Puma. Like have to physically fly the aircraft once every 90 days but you know the other month the other days inside that month you're supposed to be up on the simulator. At a minimum of 15-minute flight so you can get a rep on setting the system up and fly in it and bring it back but yeah definitely to maintain currency you should use a simulator in between live flight. If they have a pilot like if someone did a train the trainer class on it, they could teach all of the other members in their team how to fly it if you know if the time allotted but really nothing held in like a higher echelon because every single team has a different training glide path to get to the same end state. It's really decentralized here so we benefit a lot from getting max participation in that first NET training and then the trainer trainers really make their money teaching all of their team members. They go through their preflight checks, but once they go into the live fire, for us, were in non-tactical vehicles. They'll throw the SBS up get a little bit of situational awareness for the team leader maybe identify high threat target and use it to help the CAS (Close Air Support) asset called in. They are aware that's only got like 10 minutes flight time, will bring it back in, and that's it. They then go back to the gunfight, but it's generally used to help get situational awareness once the team leader has control of the SBS. It does help get a second set of eyes on potential threats and gets the team leader oriented and it helps get a second set of eyes. If possible, they use multiple assets, like the puma, along with the SBS to confirm a target or the SBS can get eyes on the rifles. It's just an additional way to get another set of eyes up and maybe they'll throw it up to try and confirm if possible. They know they're not getting any kind of grids, it's a rough estimate. Then the forward observer will use that and double check himself on the map or using GPS in the PUMA. The SBS isn't stable enough to give us a true 10-digit grid to cover fire directly on, but if we can clear the area and we get a rough estimate, we can get CAS pointed in the right direction it is help speed everything up

10. After you were initially trained on the SBS system, did the unit ever schedule sustainment training on the equipment (i.e., platoon training, sergeant time training, individual Soldier proficiency)?

Response: [Already answered]

11. Did you use the SBS during your CTC rotations or field training exercises?

Response: [Already answered]

12. Describe the biggest maintenance problem for the SBS?

Response: The landing a lot of times these guys are in a gunfight and they don't have time to stand out there and hold their arm up, slowly bring it down, and catch it. It is like, we need to we need bring this thing in and are still probably in a gun fight. Then it's doing the auto land and smacking into the gravel or maybe it's disengaging the rotors a few feet too high for it to land safely. A lot of times the tail boom [that breaks]. I've seen those get little bent from a hard landing and a little bit of wind. The aircraft is coming back in at nighttime and the rotor the main rotor flew off of the SBS while it was in flight. They recover it the next day, but I think it's really, it's just rotors and the tail boom on some hard landings, depending on where they are. The pilots never really

know where they're going to have to recover this thing. They just they try to bring it as close and soft as possible, but at the end of the day, the team leader is going to say my life is not worth this piece of equipment. It may not be an expendable item, but it's a lot more expendable than that pilot is. So, they'll bring it in the best I can to preserve the equipment, but if it means having to go out and to catch it or whatever. We've talked through some different ideas on ways to land safer, but it all depends on how much time you have. In a gunfight, you're not going to go throw a poncho out on the ground to help soften the landing. We talked about some different ideas like things that we think would be a good addition to the system that might help.

P1: Can you expand on those ideas?

A1: The way that we use it we get out of the group were using it for situational awareness. If I get out of the vehicle and I'm in a gunfight, I may or may not be able to leave that vehicle quickly. If there was like a quick launch like a hot key on the remote that was able to just get that thing a quick GPS fix. It doesn't even have to have GPS fix, if it could fix itself on the remote and fly at a certain altitude, like say 15 feet and it's going to follow the ground control station no matter where I go. That would help out a bit, but then also a little bit more accurate return to home. When I'm landing and I'm still in the gunfight, I hit another hot key on controller, and it brings it home. I just press the green button that means it's bringing it home or red button it means is bringing it home and it will return itself to that GC S station instead of me having to manually fly it. That function might be in there, but like I said a little bit of lack of training is probably a culprit there. The way to fix it that thing kicks off the rotor stops spinning and then the whole aircraft starts flipping around really quickly and so the closer you can get it to be to the ground and like the softer little bit softer landing. I don't know a way to program that in there, but I just feel like it's a little bit of a violent landing when it comes in and disengages the rotor, but with it being so lightweight though, I doubt there's a way to counter that.

Equipment Documentation (TM, Operating Manual, SOPs)

13. How did the Operator's Manual assist with operations and provide an example?

Response: I just pulled up the quick reference manual and turn it on and see if I can get it going on my own and just looking at the quick reference guide quickly learned that it wasn't that easy. Once I started reading more in the owner's manual you know like what each button means how you get it to acquire GPS the specifics on like how you rotate it the 180 degrees so it's getting it's bearing before you do the quick flick to turn it on that was all stuff that I definitely needed to read more about it. I didn't get that I didn't get that good of a class so between the owner's manual and quick reference guide it has all of the information that I can probably give it to my nephew, and he would be able to figure it out now the problem is getting someone who's been assigned to this piece of equipment who has not had the formal class. The quick reference guide wouldn't tell you what to do in emergency situation so like lots of link or loss of GPS so you know I don't know that that was in there very detailed so if there was like a one page that had kind of your emergency or GPS on it that was you know colored picture whatever little picture diagram on what to push what to do think that would help Yeah we have this thick book and I know it's chapter 4 but I you know when I start opening it up and I do all of my preflight checks so like the quick reference guide has pretty flights and then emergency procedures on it and it's all in pictures and you know little

diagrams and stuff so it's easy to use and then also on like on the hood like on the there's a hood that goes over the hand controller all of the preflight checks are on there too so as I'm holding the remote I can just look at the back of this black heard this says like step one is X Step 2 is you know Y and you know so that kind of makes it easy. I think for the SBS there is you know like a little screen or whatever if printed on there was all of the pre flights an emergency procedure kind of stuff to help.

14. What did you most commonly use the manual for? (basic functions, PMCS...)

Response: [Already answered]

15. At the team, squad, platoon, or company level did you develop any additional SOPs, smart cards, training aid, etc. for the SBS?

Response: Not that I know of. They haven't used it so extensively that guys are having to create their own little tricks. I've seen people carry it different ways like some guys have a small assault pack that they put the whole system in instead of having it like mounted on their kit you know I've seen little things like that but never uh I haven't seen anything like specific written out smart cards or anything.

16. Based on the many uses of the SBS have you included it into existing battle drills, TTPs, or SOPs? If yes, please describe.

Response: I believe there was a team to during our mission readiness exercise that's a lot less kinetic a lot more focused around getting onto a friendly militaries camp and maybe having to deal with some counter-intel people spying. I have seen then throw it up in order to try to PID or follow someone who they thought was you know collecting information on him. I have seen them send it out to kind of do like a quick check around their buildings uhm you know instead of having to send a soldier out you know do like a quick once around the building and get a look for security. I haven't seen anyone use it for clearing rooms or clearing buildings ahead of you know live Soldiers, but I have heard of people talking about the use. I think that might come with a little bit more opportunity to train you know but that that was definitely an idea people were messing around with how it how it navigates inside a building and using the like the room mapping ability to keep itself away from the walls you know and how to get through interior building without GPS I've seen people messing around with that and the idea was I had to go to into a building and I didn't know if it was clear you know I don't I don't want to offend my partner force by stacking an infantry squad on there and go through room to room and they just told me it was clear but maybe it would be a lot easier and a lot quieter to throw up SBS and fly it through there you know and not really raised too much attention.

17. Have you participated in any currency training as a dedicated SBS operator?

Response: So not on the SBS as a massive trainer. I don't know what the Army is going to say or the requirements like how frequently you are supposed to fly the SBS. I think it's probably because most people see the SBS is just another tool like a laser range finder or something that the team gets assigned and not so much like a like a Raven. you know I mean Part of the master trainer program that we have for to select national trainer UAS pilots can certify you on a Puma and a Raven.

18. Is there anything you would add to the operator's manual or the SOP and what specifically would include?

Response: I would start off with that initial feeling class and if the unit has already gotten a fielding, they probably need to get another round of training in that class. Best case scenario a master trainer certified pilot and then inside that class not only are you learning how to use that equipment but then they should teach you how to set up your mission qualified course so if I'm going to send my team members to this class these are the things that I need to show them how to do so they need to leave there with the material that they received and then they should probably as part of the graduation requirements from that class they should build their own class that they're going to teach to their team and at the end of that is a trained by trainer certificate or something or you know and says that they have accomplished preflight checks they understand emergency procedures and they know how to do these tasks or 10 tasks with the SBS you know like change the battery, change rotary, perform field maintenance, do a route using the GPS be able to fly it manually you know around certain points, do a successful recovery. They need to leave that course that they're given prepared to give a class the next day to their own people and those trainers from PEO can bless off on their course material that they created something. It doesn't take that long if they literally just sat through a class there probably just going to regurgitate the information that they got but they need to on their own computer prepare their slide show and show that they have a class prepared to give to someone else the next day on how to fly the SBS and that they understand what tasks need to be accomplished in order for someone to be a qualified pilot.

SBS Employment

19. What was the nature of your unit's mission (route clearance, armed escort, patrol)?

Response: We are set up to provide advisors to partner with whoever our partner nation is or whoever partner forces and provide a mentor like a true partner. Essentially an advice and assist mission. Some areas they probably were not going to be authorized to fly it I think it stayed in a container. Especially the hand if they think that has anything to do with gathering intelligence it's probably not going to be authorized in that Country. You know if we introduce them as Intel advisors you know or like intelligence that starts making their ears perk up and they're like are you gathering information on us or you know so if you have a sensor that this meant for essentially spying on something than probably not going to give authorization to use.

20. Was the SBS included in mission planning, if so, how? (explain what mission planning is if you feel it necessary)

Response: Honestly not that I am aware of but that doesn't mean it's not happening.

21. What types of missions did you most use the SBS for? (base defense, TCP, route clearance...)

Response: Is really one of the things that we were thinking would have really helped us use it better would have been that kind of quick follow function if we could get that implemented where you know maybe I don't have time to really sit there and go into the matrix and then fly this thing manually or even look in the screen at all but if I could quick launch it get it up and have it follow me while I'm bounding to my next position to

cover and without thinking about it the enemy one sees that there's a drone up I haven't drawn up maybe that discourages them from being too bold because now they know I will they think I can see them but it also makes it to where when I get to that position to cover all I have to do is take that remote off my hips and gain control of it now I can fly it uhm look a lot faster than if I had a completely closed up have to bound to cover get to building game fire superiority then get out and throw it up if it's already in the air following me because that quick launch function now I just gain control and fly it no Any kind of drone capability that we have is always it's always briefed as a contingency for security or whatever like they always talk about it you know like if the if the opportunity presents itself you know we have this capability that will be on call by the team leader whether to throw it up but then also because the teams are filled with such senior and trusted people you know like they are in power if that pilot has it and he sees an opportunity maybe the team leader is involved in something else they'll bring it up and be like hey Sir I'm going throw this thing up and they'll yeah they'll say OK but they understand the timing of when to when a drone is going to be beneficial and so it's definitely something that they talk about and I think that the teams have with SBS is that it's so small that it doesn't take a whole lot of planning like uh for us to do the Raven we need a reason to clear the air space and stuff so that the well I still in order to set up a training event need to have air space for the ends or for the SBS when you're in a firefight it's a lot easier to get the OK to throw that thing up and it's just it's just easier Super high altitude that I can go you know it's not too much of a worry for most people

22. Describe a mission that was successful because of the SBS?

Response: Watching 12 different teams go through the live fire scenario it was engaged very little very. Some teams who did not employ the SBS effectively because they were not able to gain quick PID of this technical vehicle they weren't able to get a good idea of how many troops are bounding on their position in their location, so it just took them longer because they're relying on the soldiers that are on the ground for their information the teams who effectively employed the SBS were able to give the team leader a lot more timely and accurate information for him to make better decisions quickly.

23. Can you think of a time when the SBS hindered a mission? (delayed a mission, stopped a mission, put personnel at risk)

Response: So, with this a team of only twelve Soldiers one to two people being pulled out of the fight to fly that thing because you know you got the one guy that is in the matrix he's only looking down in his controller and then personal security. They're out there and the SBS was not getting GPS it wasn't that cloudy like I did my other people had flown and so this one team was struggling to get GPS locking actually get it up into the air so for them it was a hindrance because they were trying to get it up to people are out of the flight out of 12 and it gave them nothing because they never got up so that guy he probably thought the system for too long before he made the decision that he wasn't going to work and just get back into the fight but for that team and not having the knowledge to troubleshoot it very well and then just the fact that it wasn't picking up GPS you know took him out of the fight. It depends on how high you fly the system so a lot of the people who use the SBS did it at night time because it's just it's limited vision it gives him that extra set of eyes with a thermal so if they were flying at too high they really couldn't tell what was going on like they couldn't see the troops granted the

troops or pop-up silhouettes so there's not a big thermal image coming from that but uh it was a little grainy and a little hard to see with any kind of altitude you know I think they were flying you know maybe 75 feet I can't I can't recall right now but I know that the teams that were flying at higher with the thermal they weren't really able to see much. Then again I attribute that to the fact that it's a giant plywood technical vehicle with no heat signature and a bunch of popups but I feel like if there was a way to get that thing a little bit more clear obviously it's going do nothing but help but I also know that it's a super small system so you know like what's the technology level right now to get a really clear picture in something that small no yeah absolutely I think it just comes with a little bit of training the pilots now they don't have to get it so high to see anything and then having them be a little bit more comfortable their comfort level with how far they can fly it away from themselves and paired with the battery life I think that was a little bit of a hindrance they know that they have 10 minutes at best if it's a little bit windy and they have to fight the wind on the way back to the recovery point you know now they're thinking I have anywhere between 5:00 and 8:00 minutes of really flying this thing so how far do I want to push it out so their counter is instead of pushing it towards what I want to look at they'll fly higher so they can see farther but then the picture quality is not good enough because at least in their mind if they just fly straight up and they can see a further distance if it crashes or whatever all they have to do is bring it straight down

24. Did you use the system the way you were taught during initial qualification or sustainment training?

Response: I don't know good answer to that because I didn't go through the training myself, so I don't know.

25. Think of a time you had to recover a downed SBS. Can you describe the event(s)?

Response: [Not applicable at his level]

26. For a future SBS configuration would you prefer:
    a. The existing configuration - Two air vehicles. One air vehicle with Electro-Optical (EO) sensors and one air vehicle with both EO and Thermal Imaging sensors
    b. A single air vehicle configuration - One air vehicle with both Electro-Optical and Thermal Imaging sensors, but capable of providing the same amount of mission coverage (twice as long as the existing air vehicles).
    c. Other configuration (Please describe)

Response : I think about how the Raven is set up, I would have multiple sets of equipment to make multiple different types of aircraft and then if a part doesn't work I can swap it out so having two air vehicle bodies with cameras that do different things that I can put on either of those aircraft allows me a lot more flexibility so if I'm flying the regular day optic on one body and that body crashes in the tail boom is broken but the camera still works and the rotors are still working I can take those parts and now essentially I have spares for the other and I can take that camera off put it on the air vehicle that still works have that day camera capability and fly that one I think just having all of the parts easily switched out and having multiple options is better you

know The regular propeller were able to clip on and off and I had you know shoot I had two vehicle bodies the propellers I can quickly replace maybe I have a little spares kit so I have to maybe two more tail rotors two more main propeller rotors and I have the day Cameron tonight camera and two vehicle bodies and maybe even an extra battery uhm if they're not going to increase if they can't increase the battery life may be an additional battery inside of that spares kit Having both helicopters in the little container and like you fly one and you return it and it it's uh it's empty put it back in there fly the other one but if I had the ability to use this you know like just switch the cameras this batteries charged up I don't want to necessarily use a thermal camera because that's the one that charge I want to use a day but I can you know plug and play.
And training and getting more hands-on training. I might be wrong on this but the system has the two aircraft and there's nothing to fix the aircraft with inside the kit so if I fly it and I break it a tail boom or I break a rotor now I only have one and the system is essentially like it's broken and now me as a commander I'm having to you know spend unit money on getting that thing fixed and you know like my tendency to want to fly it goes down so with the Raven it's an expendable system up their spare parts galore and it's easy to maintain at the operator level so with those things makes me want fly that because I know if I crash landed and the one of the wings breaks I have another way I could throw on there and continue to train and then I send that wing off to whoever in I can't remember the name place in Alabama and get a new one if the maintenance on it was a simpler process I think the people would want to train on anymore because it's a cool system but me personally I'm afraid to break it because I don't know how long it's going take for me to fix it and how much it's going to cost. About it being grounded after one flight and a more robust training so people are more comfortable with it, I think it will be fine.

27. Is there anything not covered in the interview that you would like to expand on at this time?

Response: With the SBS as far as I know it's the controller as the home, if there was a way to have a puck that I could toss out into the open there was you know kind of rugged eyes but that was the GPS location home that the SBS recognize and would return to that would be really cool and then also like I'm inside of a building and I don't necessarily want to like to have to expose myself I can toss the puck out into the open in the parking lot or behind the building and when I wanted to return to home I just hit return home and that thing flies over and lands within 5 feet of the puck. Some kind of like poncho materials something that would create a softer landing space for it like a little target. All it would have to be is spring loaded arms or like the like a wire arm that you could roll up but as soon as it doesn't have pressure it just extends out and some kind of poncho material and the puck is in the middle so I just throw it out there and it lands it doesn't matter if it's upside down right side up it's just a GPS locator and then that aircraft even if it doesn't hit it every single time it's got a pretty good chance of landing inside that little net that's probably a lot safer of a landing that's a lot cooler than what I would have thought about.

Questions Supportive of the Snowball Sampling Method

28. Is there anyone else who comes to mind you would consider as proficient with the SBS system who would be beneficial to talk to?

Response: Not right now, most of the people are that are on rear detachment.

29. Do you have their contact information?

Response: [Not applicable]

30. Can you ask them if it is ok if we contact them?

Response: [Not applicable]

Interview #: 4 SCN: AAHS-RDR-PR-20-146
Unit: 5th BN, 1st SFAB Agency ID: SFAE-SDR-SMPT-SMS

Demographics

1. What is your MOS?

Response: 35F- All-Source Intelligence Analyst

2. What position were you serving in while using the SBS system (e.g., RTO or rifleman)?

Response: I was an Intelligence Advisor on an SFAB Team.

3. What type of platoon/unit were you assigned to while using the SBS?

Response: I was on one of the actual 12-man SFAB teams as the Intel advisor. They gave all the UAS assets to the Intel advisor. I was basically in charge of the three assets we had.

4. What is your current rank?

Response: SFC

5. How long have you been in the military?

Response: 11 years.

6. How long has it been since you last used the SBS system either in training or mission?

Response: It has probably been three months.

7. Do you have experience with commercial drones or flight simulator games?

Response: One of the other UAS assets we had was the Instant Eye, which is a commercial off the shelf system piece of equipment that we were no longer able to use. I've messed kind of with the simulators for a Reapers [MQ-9s] when were downrange so that was pretty cool. And then just flying the Raven as well.

Training

8. Tell me about the initial SBS qualification training you received (NET/unit-led).

Response: I didn't receive any qualification training. I had gone through the Raven [RQ-11] IQT [Initial Qualification Training] and then I went to master trainer course for SUAS [Small Unmanned Aerial Systems] and basically, they're like, 'hey here's an SBS, you should know how to fly this."
P1: Did they provide you PEO Soldier's PowerPoint slides or what did you when learning how to fly the system, or was it just hands-on training with another guy that knew how to fly it?
A1: I didn't have the hands-on training with anybody that know how to do it. I had the little manual that comes with to like to show you how to turn it on. Then, I had to call the master SUAS school and asked, 'how do I get this thing to actually action turn on?" Because I was trying to fly it inside and I wasn't getting a GPS signal. So, that's why it wasn't turning on. Once I realized you had to spin it once, you get a GPS signal. Once I learned how to turn it on, it was basically all just hands-on learning because I didn't get any training on it.

P2: As you figured the SBS system out, did you conduct any initial qualification training for any other guys in your unit?
A2: We did some basic training because all the other Intel advisors were responsible for it. As long as they kind of knew how to use it, because we don't really use it a lot up until we couldn't fly the Instant Eye anymore. Then it went from being able to use the Instant Eye to having to use the SBS. I went over like a basic class and then once everybody knew how to fly it, I left that unit. I didn't really do any training after that and that training was prior to a live fire exercise.

9. Do you believe the SBS simulator is useful, and, if so, describe how did it improve your understanding?

Response: No, I didn't even know that was a thing.
P1: The simulator is more of the software that goes on computer with a USB handheld controller, but could you realistically say if you had that you could you see your unit running through it or using it fairly regularly?
A1: Yeah, I definitely see that being a good thing just like you have to use the Raven simulator at least every 30 days. I think doing that every 30 days would be worthwhile and I definitely think it should be required to go fly anything in the air.

10. After you were initially trained on the SBS system, did the unit ever schedule sustainment training on the equipment (i.e., platoon training, sergeant time training, individual Soldier proficiency)?

Response: No.

11. Did you use the SBS during your CTC rotations or field training exercises?

Response: So, part of our METL [Mission Essential Task List] are we have to integrate all of our SAUS systems. They have scenarios to do it and just how best to integrate it. I think the best part about it is you can attach it to yourself. So, if you're walking a long way or don't really have the ability to carry anything big, you can just take it out and start using it because it is attached to you.
P1: Is there anything as you trained yourself that you thought would be beneficial to integrate the SBS into a field problem?
A1: No, they give us a lot of leeway with whatever we want to do. One thing I wish it was able to do was a follow mode. For example, you could throw it up and if you needed to move but you don't have to move it yourself. It would just follow you or follow whoever had the GCS on. My main concern like with that [follow-me] would be just battery life I think it says like it's supposed to have a 30-minute battery life, but I've never been able to fly one for like anywhere near that amount of time.
P2: Is there anything that has restricted your ability to conduct that sustainment training?
A2: No, it's actually pretty easy for us to do any type training that we want to do. Especially for something like that. We can train right outside of our COF [Central Operating Facilities – a garrison headquarters area]. At Fort Benning, we are required to have a ROZ [Restricted Operations Zone] even for the SBS, but it's easy for us request and get. We can just go outside and throw it up allow people to mess with it and learn how to fly it. So, the process is easy. If we don't have a ROZ, we can also like fly it inside without it getting the GPS signal.
P3: Ft. Benning allows you to fly the SBS right outside your COF?

A3: Yes, as long as we get a ROZ over our area, which we do a lot of UAS training over at Kelly Hill. Which is super easy for us to get a ROZ over at Kelly Hill.
P4: What's the timeline for requesting and getting a ROZ at Ft. Benning?
A4: It's a couple days out because you have to request the land on Kelley Hill to say this the airspace, we want to operate in. You have to know at least a little bit out.
P5: Did you guys have many issues getting to that point you right now with range control to requesting land and airspace to operate the SBS?
A5: It's been pretty easy here just because you do have the Master UAS class down here, so they fly constantly. The SFAB has tons SUAS so we fly those constantly and then you also have Ranger Regiment and one of their battalions down here. Range control is pretty easy to work with when it comes to that. They just want to know what air box you are working in and it's easy from there.
P6: Was there anything else you used the SBS for during your MREs [Mission Readiness Exercises]?
A6: We used it during the MREs, and we did use it during a live fire exercise. However, it was too windy during the day. I was able to put it up and keep it behind the building, but if I would have gone above that building, I think it would have blown away. I didn't want to go above the building. At night, I was able to fly it around. The only issue was that the targets that were popping up weren't giving up any heat signature. So, we lost that ability to pick up heat signatures like in the real world. I was able to pick up our lane walkers, so it is pretty easy to use. I think it would be beneficial if the targets were giving off heat signatures to be able to tell exactly where they're at.
P7: How are you relaying that target info to the guys maneuvering on the ranges? Was it over comms or where you right there with the maneuver element?
A7: We maneuvered together. I was part of the maneuver team [as the SBS operator]. My commander was right there with me. He was making all the calls and we also had a JFO [Joint Fires Observer] qualified guy that was controlling any like weapons team we had.

12. Describe the biggest maintenance problem for the SBS?

Response: When we did the life fire because we did so many different iterations, I would notice that every now and then, even if I seeded it correctly into the charger, it would not always charge. For example, I'd go to pull it out again and the bird would be dead, even though it should have been charging for several hours. I would put it back in and it would get some charge. The charging wasn't always perfect. I don't know if it's battery issue or if it was just the hand controller or what.
P1: I'm assuming that the work around was to keep re-seating it until the connections were good?
A1: Yeah, that wasn't always a work around, but it just sucks when we were in a firefight wanting to use it and the batteries were dead. I would go to throw it up and well this is dead. However, you could always just try the other one [air vehicle].

Response 2: Battery Life and Winds

Equipment Documentation (TM, Operating Manual, SOPs)

13. How did the Operator's Manual assist with operations and provide an example?

Response: [Not asked]

P1: Have you ever had that reference the operator's manual for anything maintenance wise?
A1: No, not really. If I ever had any problems, I would just call our brigade master trainer and he always had the answers for me.

14. What did you most commonly use the manual for? (basic functions, PMCS...)

Response: I used the operator's manual to learn how to use it. That was how I learned how to turn on, how to select which bird I wanted.
P1: Have you ever encountered a situation where you did not find the answer in the manual?
A1: No. I always just messed with the system and then learned it. I don't know how to turn from EO to IR to like there's a thermal setting on there, as well. I just mess with it, and it is pretty user friendly. I learn how to do different types of things.

15. At the team, squad, platoon, or company level did you develop any additional SOPs, smart cards, training aid, etc. for the SBS?

Response: No. My experience with it was really short because I'm actually not on that team anymore. I got moved to battalion-level and the battalion I'm in the unit doesn't have any SBS, but I definitely think that would be a good time to use especially if the unit has multiple UAS assets they can use – like when would be a right time to use which UAS asset and how to use it.

16. Based on the many uses of the SBS have you included it into existing battle drills, TTPs, or SOPs? If yes, please describe.

Response: So, like internal we discussed when would be the right point to launch it whenever we came in contact, but as an SVAB team if you're coming into contact, like we train, it would be like a failed mission anyways. Other than that, we didn't really have anything. And the Commander just left it up to me to when to put it up.
P1: What was your point when you would launch it, whether formalized or from your experience that this is the trigger event?
A1: It would be in a secured area where we had cover and concealment. We can effectively operate it and see where everything was – we're not out of danger but not in an open area, not at the point of contact.
P2: Did you have any general guidelines where it was a secure location but maybe not farther than 500 meters or 400 meters from the target you want to look at or was it METT-TC dependent?
A2: Yeah, if the target was too far, I'd recommend not throwing it up to my Commander. If the Commander really wanted to throw it up, I'd throw it up and let him see that he can't see through that part with it.

17. Have you participated in any currency training as a dedicated SBS operator?

Response: No, we didn't have it for that, but I mean obviously we had it with the Raven. We just didn't want to run full system simultaneously, but I definitely think we should have.
P1: What do you think a general time frame would be for the currency requirements
A1: I would stick with the RAVEN system – so every 150 days of actual flights and every 30 days the simulator. And if you're in a unit that has both of them it's too easy to do them simultaneously.
P2: Do you feel that having some kind of annual evaluation would be worthwhile?

A2: Yeah, I definitely think it would be worthwhile because it would show them how to use it, why you use it, and you're not just flying around looking at nothing.

18. Is there anything you would add to the operator's manual or the SOP and what specifically would include?

Response: Not really, but I do think that there should be at least some type of qualification training to be able to fly it because what I'm tracking now is that there's no mandatory IQT with it. It's like here's the system you can go fly it, but I think there should be something like a day or a week to have operators be able to actually use it. That way they can also learn like the system limitations because when I was talking about the wind, when one of our guys he threw it up and like the wind almost blew it away because it was too windy, but he wasn't thinking about it and it took a while to get it back.

P1: What would you implement in the qualification training you just talked about or what would that entail or what do you think the most critical things that need to be taught and whether it's evaluated or not?

A1: Definitely system's limitations, controlling the airspace a little bit, just a basic airspace class. I if you're giving it to like a PFC and you're also have different fires assets in there, I mean granted it flies so low it's probably not going to be an issue but like just a basic airspace class I think would be beneficial for anybody flying anything in the air. And all the different functions that you can have with it – like how you can trick it into like going to follow mode would be beneficial.

P2: Any kind of formal evaluation of the course or more of just you know you've met all these tasks generally within the standard?

A2: Yeah, I wouldn't say like a test at the end of it, but a demonstration that shows you know how to fly this and do all the different tasks with it.

P3: One of the other interviews the guys talked about the benefits of doing both day and night during initial training. Would you agree or disagree with that statement?

A3: Yeah, I definitely agree because when we did our Night Live Fire, I was actually flying it is a lot more difficult than I thought it was going to be. I had the beacons on it but it's still pretty hard to see flying it at night. You have NODs but you can't look at the [SBS] screen with NODs. And going back and forth is a little hard to find it and it would be harder at night if you don't really know what you're doing.

SBS Employment

19. What was the nature of your unit's mission (route clearance, armed escort, patrol)?

Response: We used it for anything that was close that we needed to look at that we didn't really want to send anybody. Even if we did have access, we would still use it like the Instant Eye. A scenario was, we did a team mission readiness exercise, and somebody brought a box to our CP [Command Post] and said, "hey can you guys take this" and the box had had wires sticking out of it. We told him to go like put in the woods away from everybody. We don't have any robots go look for it or any DoD assets, but we had an engineer, so we flew the SBS over the box and looked at it from all different angles. But something that's like very close, I don't know necessarily we would use it for anything long range, well you can't really use long range. I know that there's an extended range antenna, but I still don't like sending it much further than a few hundred meters.

20. Was the SBS included in mission planning, if so, how? (explain what mission planning is if you feel it necessary)

Response: It was included in the mission planning specifically because it was always a task that we had to do. Whether it was specifically SBS or just all of our systems, you always included in mission planning and even if it wasn't just as the like the senior leaders that we had on our team like we always include it and especially since it's one of my main jobs on the team if we get into that situation is playing that. So, it would always be included at least in my situation.

21. What types of missions did you most use the SBS for? (base defense, TCP, route clearance...)

Response: I only used it a few times, but I would definitely say more like our MRE and conducting close reconnaissance, like any type of flying around our COP would be used by an SFAB team.

P1: When you mean around the COP, more of a base defense?

A1: Anything like close base defense. Obviously, can't fly it that far, but it does allow you to go see stuff without having to go.

P2: The times you did include it in the base defense, was it was it planned or was it like you thought there's something out there, so you wanted to check it out?

A2: It's always part of our basic defense plan and then just METT-TC whether we actually used or not. We have those different assets available to us if it doesn't meet certain criteria.

22. Describe a mission that was successful because of the SBS?

Response: I've never used it in a real-world environment, but it's definitely successful when we did our life fire exercises because we were able to see which direction those targets were, if they were individuals, we would be able to see exactly where they're at, where we need to put our fires assets.

P1: You said you did have a FSO with you there when you did the live fire exercise.

A1: Yeah, we had a JFO

P2: Was the JFO looking over your shoulder or what was the interaction between you and the JFO?

A2: He was standing right next to me and he had, I don't remember which asset, a simulated asset. But he was talking to his asset while I was controlling the bird. I just relayed him information.

23. Can you think of a time when the SBS hindered a mission? (delayed a mission, stopped a mission, put personnel at risk)

Response: No, because it is so tiny that I would say it wouldn't hinder any mission unless you just use it in the wrong instance. I never had that issue; it's never gotten in the way. So, I would say it never hindered any mission. I would say one thing, if it did blow away it would definitely hinder a mission, but I never had that problem.

24. Did you use the system the way you were taught during initial qualification or sustainment training?

Response: [answered previously]

25. Think of a time you had to recover a downed SBS. Can you describe the event(s)?

Response: Not for SBS, but I have done it for Ravens.
P1: Is recovery operations something you could foresee as the SBS get fielded that a recovery of the SBS gets built into the missions (If you're in your secure OP and it does go down at some point someone would have to go grab it)?
A1: Yeah, I would think that would be extremely hard with how tiny it is. And just trying to be able to figure out exactly where it's at, especially if you're flying it at night and it gets blown away. I would think it would be almost impossible.
P2: When you were doing any kind of training, like getting yourself up to speed, have you ever crashed one and had to locate it whether it was chirping or looking at the video feed?
A2: No, I haven't. I never threw it up in a situation where I thought I would lose it. If the wind was too much, I wouldn't fly it just because we do have those other assets that can fly in higher winds and just makes a little bit easier.

26. For a future SBS configuration would you prefer:
    a. The existing configuration - Two air vehicles. One air vehicle with Electro-Optical (EO) sensors and one air vehicle with both EO and Thermal Imaging sensors
    b. A single air vehicle configuration - One air vehicle with both Electro-Optical and Thermal Imaging sensors, but capable of providing the same amount of mission coverage (twice as long as the existing air vehicles).
    c. Other configuration (Please describe)

Response: I definitely like the two air vehicles because it gives you a little bit longer battery life; once one dies you can throw another one up. And if one didn't charge for whatever reason you have that spare time. So, just having a spare is always good especially if you're dismounted. But I do think giving it a longer range and a better sensor would be more beneficial than just having two. If you can increase the limitations on wind and increase sensor, as well as the battery life, it would definitely be better than having two.
P1: Now to dive into the sensor, I'm assuming you're talking about better quality, like maybe a gimbal payload, or what's the capability that you'd like to see improved on the cameras?
A1: Yeah, I mean obviously if it was a gimbal payload then that would be way better. Even though it's not a gimbal, it's still easy to maneuver it because you can maneuver the bird, you can have it hover. So, having a gimbal payload is not necessarily required. But better the clarity from it
P2: Have you guys had any parts issues, like getting replacement parts in, or the propellers break way more frequently than you would think or anything along parts and supplies chain?
A2: No, I've never really had any issues with it. I didn't find that it broke too easy, especially if you've flown a Raven before those things break all the time so if you get used to that this is pretty sturdy.

27. Is there anything not covered in the interview that you would like to expand on at this time?

Response: I would say make sure that all the systems come with maps. I've never used a system with a map, but I can imagine things you can do with it would be a lot better than without the Maps. So just make sure all the systems come with maps; don't let a unit purchase it without maps – I don't know why I unit did. And make sure that training actually gets done with the operators, not just like here's a system and go figure this out.

Response 2: Our systems are missing the Maps. I guess our unit didn't purchase the Maps that go along with it, and so like creating a mission in there just kind of difficult. Basically, all we use it for is putting it up doing close air reconnaissance with it and then bringing it back.

Questions Supportive of the Snowball Sampling Method

28. Is there anyone else who comes to mind you would consider as proficient with the SBS system who would be beneficial to talk to?

Response: Most people I know are in Africa right now. I am on team whose mission got cancelled. So, the teams in Africa probably won't be able to do it right now. I don't really know anybody else and the only other person I would think of, I believe that you guys have already been speaking with him.

29. Do you have their contact information?

Response: [Not applicable]

30. Can you ask them if it is ok if we contact them?

Response: [Not applicable]

Interview #: 5 SCN: AAHS-RDR-PR-20-146
Unit: 3rd BCT, 82nd ABN DIV Agency ID: SFAE-SDR-SMPT-SMS

Demographics

1. What is your MOS?

Response: 19D Cav Scout

2. What position were you serving in while using the SBS system (e.g., RTO or rifleman)?

Response: Dismounted Team Leader

3. What type of platoon/unit were you assigned to while using the SBS?

Response: Recon Platoon

4. What is your current rank?

Response: SGT

5. How long have you been in the military?

Response:9 years

6. How long has it been since you last used the SBS system either in training or mission?

Response: 6 months

7. Do you have experience with commercial drones or flight simulator games?

Response: No

Training

8. Tell me about the initial SBS qualification training you received (NET/unit-led).

Response: It was through PEO Soldier. It was about a 72 hours course, throughout five days.
P1: Can you describe the training in more detail?
A1: Classroom training that took forever and they had a power point for every single bit of info that they could ever think of. They had videos and they showed a live feed on how to operate the SBS. We did 2 days of classroom, then we did a day of the SBS simulator where you're on a computer simulator in a quiet environment using the controls. The last few days we spent outside actually flying it, building route plans, rally points, and everything else. On the last day they answered any questions we had. If we were struggling, they'd make sure to help us and we helped each other. Helping someone else helped us learn the system better.
P2: Did you participate in both SBS NETs, the first one being prior to your deployment in 2019 and the second was conducted in July of this year?
A2: No, I only did the NET before our deployment.
P3: On a scale from 1-10 how comfortable did you feel operating the system?
A3: about a 7
P4: Is there anything you would do to improve the training?
A4: Not really
P5: Did everyone get hands on flight training?
A5: Yes, sir.

9. Do you believe the SBS simulator is useful, and, if so, describe how did it improve your understanding?

Response: Yeah, it helps you learn to control it before went out there I'm on you again lose it.
P1: Is there anything you would do to improve the simulator?
A1: More training on how to start up the SBS and on GPS denied mode, that would be helpful because a lot people were failing that.
P2: What's the most important thing you learn season simulator that you were able to apply that into when you had to fly it?
A2: It was just what the button controls were, so I wasn't all fidgety when it came to actual flight time. I was able to comprehend it and where up, down, how turn it, and how to make your small adjustments.

10. After you were initially trained on the SBS system, did the unit ever schedule sustainment training on the equipment (i.e., platoon training, sergeant time training, individual Soldier proficiency)?

Response: No

11. Did you use the SBS during your CTC rotations or field training exercises?

Response: Did not have any CTCs or FTX prior to the deployment with the SBS.

12. Describe the biggest maintenance problem for the SBS?

Response: The battery draining rapidly due to heat. After using it for so long with this drain itself so you turn on if they had 25 minutes guys like it supposed to you fly for maybe when it happened it was blinking out you got about ready to die and get ready to drop off
P1: Did the operators manual help with this at all?
A1: There's nothing out there or any tips. The operator's manual provided a temperature range at which the batteries were more efficient.
P2: Did you have to adjust the way you employed the SBS?
A2: Yes, I did. I was carrying it a lot more, and then I had to wait until I was in a vehicle so I can have it plugged in and make sure one air vehicle is charging in the vehicle while I was operating the other.

Equipment Documentation (TM, Operating Manual, SOPs)

13. How did the Operator's Manual assist with operations and provide an example?

Response: I really only referenced it to figure out how to hook up to a computer. That was our biggest issues, trying to link it to computers.
P1: Can you expand on that a little bit more, why did you want to hook it up to the computer?
A1: When we would go out to find intelligence, we used it to check areas and we wanted to review the video with the S2 to build reports. We could not pull the video straight from the air vehicle to give to the S2. We would end up giving the entire system to the S2 so they could pull the video. But they couldn't get the data pulled off either. So, they would just look at it and be like "ok, cool, sorry we couldn't use it to build any sort of portfolio on somebody or anything else like that. There was that little bit of this task included in the initial training and qualification that the NET taught on you how to

upload it onto the computers or set it up into a computer. They showed us on their own computers how to do it. You must go into your computer to change the IP address to match what the SBS needed. If you didn't remember what IP address your computer was before, it messed up the computer. Then S6 would have to fix the computer with the correct IP address for it otherwise it wasn't working.

14. What did you most commonly use the manual for? (basic functions, PMCS...)

Response: [answered above]

15. At the team, squad, platoon, or company level did you develop any additional SOPs, smart cards, training aid, etc. for the SBS?

Response: No because I was the only operator, and I knew how to use it so there was no need for smart cards.

16. Based on the many uses of the SBS have you included it into existing battle drills, TTPs, or SOPs? If yes, please describe.

Response: We would use it to clear blind spots.

17. Have you participated in any currency training as a dedicated SBS operator?

Response: There are no mandatory hours. No one logged our hours, so we have no way to look back on it or the specifics of how long we're flying. In that environment, it doesn't matter the required flight time.

18. Is there anything you would add to the operator's manual or the SOP and what specifically would include?

Response: No sir. The operator's manual was detailed.

SBS Employment

19. What was the nature of your unit's mission (route clearance, armed escort, patrol)?

Response: Reconnaissance

20. Was the SBS included in mission planning, if so, how? (explain what mission planning is if you feel it necessary)

Response: It was part of every pre-mission brief we had. They always included the SBS and we knew exactly when or where we would employ it. There were always those on-the-fly calls to employ the SBS like to check out a grid or clear an area.
P1: What was included into that pre-mission brief? (triggering event, duration of flight, altitude)
A1: They gave me the grids of certain houses or compounds or anything else that they got from S2 that was suspicious or that they wanted to check out. They gave me those beforehand so I could program them into the mission planning tool. So, all we had to do when we got to the location was coordinate airspace. Occasionally, an issue was having to wait for maybe an hour or two to get airspace approved.

21. What types of missions did you most use the SBS for? (base defense, TCP, route clearance...)

Response: We had the engineers for route clearance, so we didn't particularly need it for that. We did a couple of patrols through villages, to an objective, where I would use it to check suspicious individuals. We would look a bit ahead of us, so we were not walking completely blind.

22. Describe a mission that was successful because of the SBS?

Response: No, I can't think of anything.

23. Can you think of a time when the SBS hindered a mission? (delayed a mission, stopped a mission, put personnel at risk)

Response: The battery was a problem a few times. The winds carried the SBS off course and we had to stop a mission to go retrieve it.
P1: During recovery operation of the SBS can you describe how it is that you found the system?
A1: The entire time the SBS is on it is giving you a current grid of whatever it's looking at. As long as you don't stop the footage or video feed it will give you the grid, so you just use that grid to walk out to find it. It will also provide a distance and direction from your position to the SBS. As long as it still has battery life, you can use the "find UAV" function and locate the SBS, and it has a flashing light you can use to find it at night.
P2: Was this something that was taught to you during initial training or did you have to find this out on your own?
A2: It was taught to us.
P3: Do you do you think the resolution of the payload is sufficient to do reconnaissance missions?
A3: The daytime camera was very good; I could see license plates and faces very clearly at a certain height. The nighttime camera was a struggle.
P4: Can you can you expand on that a little bit more, what was it about the nighttime camera?
A4: The nighttime camera resolution was way worse. You really couldn't clear it up like you could the daytime. It didn't matter it was always pixelated and the field of view was smaller.

24. Did you use the system the way you were taught during initial qualification or sustainment training?

Response: [answered above]

25. Think of a time you had to recover a downed SBS. Can you describe the event(s)?

Response: The entire time the SBS is on it is giving you a current grid of whatever it's looking at. If you don't delete the footage or stop video feed it will give you the grid. Just use that grid to walk out to find it. It will also provide a distance and direction from your position to the SBS. If it still has battery life, you can use the "find UAV" function and locate the SBS, and it has a flashing light you can use to find it at night.
P1: Was this something that was taught to you during initial training or did you have to find this out on your own?
A1: It was taught to us

26. For a future SBS configuration would you prefer:

Response: Both birds would be fine, but I would recommend moving a camera to the bottom of the bird so you can see directly down. This could be used to hover over an area. You could fly to the location and set the SBS to fly circles around that location. You can actually pick the center grid of the desired location have the SBS do 10-meter circle around it and the operator can look straight down instead of having to back off to make sure you can see the entire compound.

27. Is there anything not covered in the interview that you would like to expand on at this time?

Response: We struggled hard trying to get replacement parts. We had a couple of propellers break, one of the cameras broke, and we had an entire bird down for most of the deployment because no one knew how to get replacement parts. Not all systems came with all pieces of equipment. Not all systems had an external charger or extended range antenna. We need the 2590 battery charging cables. I would be able to carry that with me on patrol and charge the SBS instead of going to back to the vehicle and wait for it to charge. We need the external antennas to be able to extend the range of the SBS. With the external antenna I was able to fly over 1 ½ kilometers before having connection problems. Also, we were initially given a nylon carrying case, it was a throw-away case. We were then given MOLLE carrying cases that were superior. We could set the system on our kit comfortably and place the display so myself and others around me could watch the SBS feed. Additionally, the controls could be better configured. I know in my generation we are all about the video games; the controller may be turned into more like a console controller. This would make it easier for operators because it would be like playing Call of Duty or playing racing games. The one hand controller makes it difficult, because you have to make sure you can press the buttons fast enough or don't accidentally press the rotate button three times. I think it would be easier to control if the SBS controller was like a video game controller.

Questions Supportive of the Snowball Sampling Method

28. Is there anyone else who comes to mind you would consider as proficient with the SBS system who would be beneficial to talk to?

Response: I know one of the operators, but he is in the middle of gunnery so he will not have much time to do anything. He should be back within the week; he's the one I know operated the SBS. He went through the course.

29. Do you have their contact information?

Response: Sergeant? also in Bravo troop 5-73 CAV. Also, they have been sending us emails about this interview to our government emails. Most of us do not have any reason to check that email. The best way to get a hold of us is through cell phone or through 1sg.
P: What is your 1sg's name?
A: 1SG Wilfredo Rivera-Delatorre

30. Can you ask them if it is ok if we contact them?
Response: I will.

Interview #: 6 SCN: AAHS-RDR-PR-20-146
Unit: 1st BCT, 25th INF DIV Agency ID: SFAE-SDR-SMPT-SMS

Demographics

1. What is your MOS?

Response: 17E - electronic warfare specialist.

2. What position were you serving in while using the SBS system (e.g., RTO or rifleman)?

Response: I work in the S3.

3. What type of platoon/unit were you assigned to while using the SBS?

Response: Infantry unit.

4. What is your current rank?

Response: SFC.

5. How long have you been in the military?

Response:15 and a 1/2 years

6. How long has it been since you last used the SBS system either in training or mission?

Response: Three days. I was conducting training for some soldiers within my brigade.

7. Do you have experience with commercial drones or flight simulator games?

Response: Flight simulators. I grew up around them since I was 13 years old. I've been in a program called Civil Air Patrol, and just absolutely love flying. As far as drones go that's been entirely military through Ravens since 2009 all the way through now. And now the SBS.

Training

8. Tell me about the initial SBS qualification training you received (NET/unit-led).

Response: Last year approximately August timeframe; right before I deployed, a NET team from North Carolina flew out here and provided us about two full days of training to include going off post and doing some training at another location.
P1: Was the training in a classroom and then in a field setting, or was it all in a building?
A1: Classroom and field. Everything was prior coordinated and worked out quite well
P2: Was that team that came out they were a NET team?
A2: yes, they are from project manager.
P3: On a scale from 1-10 (10 being the highest confidence) how confident did you feel with executing the learned tasks?
A3: Probably about an 8; wish we had more time to fly.
P4: What would you do to improve it – could you expand on that?
A4: More hands-on training, but the issue was the Fort Wainwright is kind of unique in that we're such a small installation. The insulation is centered almost entirely around an airfield which just makes getting in flight time a little bit hard.
P5: Did every soldier in the class get to conduct hands-on flight training?
A5: Yes.

9. Do you believe the SBS simulator is useful, and, if so, describe how did it improve your understanding?

Response: I was provided the SBS prior to the class. I read through the manual initially, this was before the class, and even started it. When I sat down at the simulator and already fully understood what was required, but the simulator without a doubt got me good hands-on training prior to actually flying a live aircraft which allowed for a less chance of crashing the system and causing damage.
P1: Is there anything that could be done to improve the simulator?
A1: Nothing I see at this point
P2: What is the most important thing you have learned using the simulator that is transferred into your training or operational deployment of the SBS?
A2: One word – buttonology. Understanding which buttons do what without having a live aircraft that could crash because if you make a mistake on the simulator it doesn't cost any additional money.

10. After you were initially trained on the SBS system, did the unit ever schedule sustainment training on the equipment (i.e., platoon training, sergeant time training, individual Soldier proficiency)?

Response: We packed up the SBS immediately after the training and I deployed roughly about a week and a half after that. As soon as the containers arrived, and we were able to unpack them I started doing local training for my soldiers within my TOC every so often. I'd say roughly about once or twice a month maybe less often than that depending upon our actual OPTEMPO. At that time, it is more of an opportunity type training.
P1: Was there any specific part of that training because it was a deployed environment that assisted with future operations?
A1: Unfortunately, no. Our operations that my battalion specifically had, did not require the use of the SBS because it was mainly just an essentially for logistics patrols. We had some partner forces, who requested use of the system for some of their own purposes because they had never seen anything like it and absolutely loved it. But it was a marine special operations and Canadian special operations
P2: Do you have any recommendations to improve unit sustainment training?
A2: Our biggest thing is just going to be to ensure that we've got periods of time on our training schedule set aside. Because I work in S-3, I need to follow up with FRAGOs. Also, I have an additional duty as the brigade UAS master trainer, so I do teach Ravens.
P3: Is there anything that has restricted your ability to conduct sustainment training?
A3: Airspace, and we just got fielded the new systems while the rest are still in transit back. Since we've returned, we are continually just trying to get it back. COVID has been our biggest thing preventing us from holding classes; that's really the big piece.

11. Did you use the SBS during your CTC rotations or field training exercises?

Response: I have. I took one out with a field training exercise going on for 4th brigade 25th ID. In the field they asked me to come out and do some Raven training and because I had one [SBS] I grabbed one system and just did a real quick down and dirty class for them on it [SBS] while we were waiting for other systems to be prepared and ready to go.
P1: What type of training event was it and then at what level was it held?

A1: A battalion-level field training exercise
P2: Do you know what the mission was and how you employed the SBS system to support that mission?
A2: They were doing some live fire ranges and they just wanted some oversight on those ranges.

12. Describe the biggest maintenance problem for the SBS?

Response: Lack of spare parts in order to replace broken parts. We understand that crashes are going to happen. One spare main propeller for two aircraft I would say is most definitely not enough to have on-hand. If the system as a whole or even the brigades issues it or they come with a larger number of spare parts, that would drastically help maintenance on the system. What would be extremely simple is just having those extra parts on-hand to be able to ensure that you've got a fully functioning system is a requirement that's not fulfilled by the filling [NET/NEF package].
P1: Was the operators manual helpful in anyway?
A1: Yes
P2: Could you describe how it was helpful?
A2: I'm one of those weird soldiers that actually likes to read manuals and figure out what's going on beforehand that way I know what I'm getting myself into. Everything in that manual is directly tied to complete operation of the system. Without knowing what I'm looking for it covered full functionality to a point that even if there wasn't a simulator, I felt comfortable taking control of the system. I am very happy that the simulator was there because it helped out immensely as well, but it [the operator's manual] gave me everything I needed to know.
P3: Can you describe how the maintenance was modified in a deployed or field environment?
A3: Actually No.
P4: Can you describe a time when you had to adjust how you operate the system to avoid a maintenance problem?
A4: No; Maintenance on that is so extremely simple; take off and replace a propeller or pop the camera back on because they pop loose when the aircraft hits a tree. It's extremely simple down to the individual soldier-level.
P5: Have you found any creative ways to minimize maintenance problems while employing the SBS system?
A5: I do have something, but I don't know if it ties in with maintenance type question it's just an overall fielding. So, the system is issued with what looks like a standard laptop plug controller. One thing that I would highly suggest as an alternative to that is the Raven vampire ITS system comes with a plug for. It looks almost exactly the same as a standard computer plug but at the opposite end of it looks like the BB 2590 or any of your standard ASIP batteries. If every single system was to have a battery cable that can plug into your standard ASIP batteries, which is currently an additional authorized item, the soldier would now have full capability the charge off of 110 to 220 or even off of any of the standard army issue batteries. Like I said the vampire ITS, which stands for institutional training system, comes with those plugs. We tested/verified that it works without causing any issues to the system because it's already set to 12 or 24 Volt which the SBS is already set up to accept as an external power source.

Equipment Documentation (TM, Operating Manual, SOPs)

13. How did the Operator's Manual assist with operations and provide an example?

Response: I personally utilized one of our systems to do a defensive view of the perimeter. When we're deployed, we would try to see what another UAS operator could see from the outside looking in and try to harden our overall defensive posture. That drastically helped us out because trying to do that with a Raven that's continuously moving versus one that you can stop and hover and look at it was a lot easier to do.

14. What did you most commonly use the manual for? (basic functions, PMCS...)

Response: I've used it to assist with teaching classes and then just a quick glance if I need to go back and do something or see something that I didn't quite remember like wind speed or just general guidelines for flying. Like I said, I read the manual beforehand which immensely helped myself out. I don't know that there's a lot of other soldiers that do that kind of thing, but overall, it was really good to have on-hand

P1: Was that included in the initial qualification training?

A1: Yes

P2: Some of the things that you went back and refer to the manual was that pointed out or was that used?

A2: Yes, everything was pointed out in the initial qualification course, but we went through after we came back from deployment just trying to remember what the limitations were of the system exactly

P3: Did you ever encounter a situation where you did not find answer in the manual?

A3: No

15. At the team, squad, platoon, or company level did you develop any additional SOPs, smart cards, training aid, etc. for the SBS?

Response: Not that I have seen. Kind of wish that I had done that, but OPTEMPO was so extremely high through the deployment that its kind of went by the wayside. I was able to do 2 initial operator courses when we were deployed, as well as doing Raven training, and then just all of our standard operational stuff that we were doing. Sometimes SOPs can be a hindrance and hard to create. One thing we do have is our airworthiness release and our brigades' overall guidance it's not really an SOP it's more just a memo saying this is very basic what it is and how to basically use it. It's not really a full SOP just a general guidance.

P1: Would it be possible to potentially get a copy of that?

A1: I can talk to chief Bud [sending it to Oscar or Josh].

16. Based on the many uses of the SBS have you included it into existing battle drills, TTPs, or SOPs? If yes, please describe.

Response: No. I do know that our scout platoon is they're trying to incorporate it into their stuff. But I don't think it's been a codified into an SOP for them.

17. Have you participated in any currency training as a dedicated SBS operator?

Response: Yes. That was last week

P1: Does your unit have a currency requirement for example is it 30 days 60 days 90 days?

A1: No. During the initial operator course, they said that there were no currency requirements as long as you have been trained on the system, you're good to continue

flying. Your understanding of which button does what (buttonology) may lax, but with how simple the system is to operate you can pick it right back up and run with it. So, no currency requirements.
P2: Do you think that the currency requirement helped you with your confidence levels on the use of the SBS?
A2: No.
P3: Does your unit have any annual evaluation criteria to maintain your qualification?
A3: No

18. Is there anything you would add to the operator's manual or the SOP and what specifically would include?

Response: Nothing right now.

SBS Employment

19. What was the nature of your unit's mission (route clearance, armed escort, patrol)?

Response: A deployed mission was to secure a Fob in Mosul and follow-on close down that post to move to another location. Our current mission is we are up here in Alaska as the nation's Arctic Warriors.

20. Was the SBS included in mission planning, if so, how? (explain what mission planning is if you feel it necessary)

Response: No because individual lower missions it was not utilized; just mainly based on defense.

21. What types of missions did you most use the SBS for? (base defense, TCP, route clearance...)

Response: Base defense. That was really the only thing that we did. Route clearance was done by an engineer unit prior to us.
P1: Could you walk me through an example for base defense, how was the SBS used for you know for example clearing culverts, flying over, and checking vehicles etc.)
A1: We would use it for if we saw anything outside base that looked different. We could fly over to it just to get a better look at it without risking life, limb, or eyesight. And then we also utilized it to do a fly over of our base and look in on our base to see what kind of vulnerabilities we have; so, vulnerability assessment that's what I was looking for.

22. Describe a mission that was successful because of the SBS?

Response: Hardening our defensive posture. Without a doubt, it was done better because of that. We used it both day and night to see what we look like from the outside

23. Can you think of a time when the SBS hindered a mission? (delayed a mission, stopped a mission, put personnel at risk)

Response: No.
P1: Is the payload resolution sufficient to conduct the missions you went on?
A1: It was good enough for what we needed there. There are times when it does get fairly pixelated, but you can change your altitude or change your distance to fix.

24. Did you use the system the way you were taught during initial qualification or sustainment training?

Response: Yes.
P1: Did you find any ways to modify those tasks?
A1: No; everything is pretty straightforward and simple as long as you follow what it says. There are no real ways to change or tricks around anything of the software. Everything that's built into the system is extremely intuitive and makes for pretty standard operating.

25. Think of a time you had to recover a downed SBS. Can you describe the event(s)?

Response: The only times that the aircraft went down was on post, so it was a simple walk to it pick it up. We did not have to utilize the built-in software to go find it. As far as from a training perspective, recovery of the down SBS is part of the training and the built-in software along with GPS made it extremely simple to find it. I crashed probably about 5 to six times throughout the course of the year that I've been messing with them.

26. For a future SBS configuration would you prefer:
    a. The existing configuration - Two air vehicles. One air vehicle with Electro-Optical (EO) sensors and one air vehicle with both EO and Thermal Imaging sensors
    b. A single air vehicle configuration - One air vehicle with both Electro-Optical and Thermal Imaging sensors, but capable of providing the same amount of mission coverage (twice as long as the existing air vehicles).
    c. Other configuration (Please describe)

Response: Maintaining the two aircraft with two different payload capabilities. It comes immensely helpful having the ability to look higher and look lower with the day aircraft, as well as having the night aircraft. I would like the sensor on the night system to be wider, but as long as you're able and willing to maneuver the aircraft you can look at whatever you need to in the current configuration.

27. Is there anything not covered in the interview that you would like to expand on at this time?

Response: Just a secondary along with what I already mentioned in regard to the power capabilities; we really need the external antennas and the antenna cables that go with them. That was one thing that we didn't have, and it drastically reduces your range to about 1 to 1/2 K max. There was a couple of times where we would have liked to go out a bit further than that simply because of the threat that was there, but we were unable to do that due to the system's limitations. Limitation of ranges is the biggest problem.

Questions Supportive of the Snowball Sampling Method

28. Is there anyone else who comes to mind you would consider as proficient with the SBS system who would be beneficial to talk to?

Response: I can get with some of my scouts but really their use of the system was nowhere near as much as mine. They just did initial training and then after training, they just kind of kept theirs in a box.

29. Do you have their contact information?

Response: Yes

30. Can you ask them if it is ok if we contact them?

Response: Yes

Interview #: 7
Unit: 3rd BCT, 82nd ABN DIV

SCN: AAHS-RDR-PR-20-146
Agency ID: SFAE-SDR-SMPT-SMS

Demographics

1. What is your MOS?

Response: 150U; the MOS title is a UAS operations technician or UAS technician.

2. What position were you serving in while using the SBS system (e.g., RTO or rifleman)?

Response: I was the brigade UAS operations officers during fielding and during this last deployment for the SBS.

3. What type of platoon/unit were you assigned to while using the SBS?

Response: My unit is HHC 3-82, and then as far as ADCON concern is that we fall underneath the engineer battalion as a brigade, so we are a separate company. So basically, everyone from the brigade commander in the HHC all the way down to the supply sergeant falls underneath that company in that engineer battalion. All our paperwork processes go through there [BEB]. Even though I work for the Colonel, all my paperwork goes through how the BEB's channel.

4. What is your current rank?

Response: CW4

5. How long have you been in the military?

Response: Next year is 20 years.

6. How long has it been since you last used the SBS system either in training or mission?

Response: We have with the combined arms exercise. So, what it is it's a company validation for the rifle company and the infantry battalion where we work of fires with not only the organic fireteams in the Delta companies which is the modern truck guys we also incorporated artillery AH64 attack aviation and larger UAS like the Grey Eagle and the Shadow [so it was a combined arm].

7. Do you have experience with commercial drones or flight simulator games?

Response: I do not. Prior to UAS I flew helicopters for 10 years. Most of my military career is aviation based but my only exposure to UAS started in 2015. I don't have any type of civilian experience with it; it's just on the professional military side.

Training

8. Tell me about the initial SBS qualification training you received (NET/unit-led).

Response: The initial training that we received encompassed three days essentially. We had primary training update, applied operations day, and then an alibi day. So, the first day encompasses basically death by PowerPoint for lack of a better term and then more in the afternoon we got into the hand-on stuff with some outdoor flying, some indoor flying with GPS denied. And then the second day which is primary flight we moved out to a mount site inside the training area and we flew in an urban environment and then an open environment working through some of the tasks. There were some, I guess I don't want to say gaps, but following the MOI some of the soldiers weren't

picking it up so the course was accelerating faster than they can digest the information just because it they can memorize stuff and they could like it see stuff that they couldn't correlate between what they're seeing what they're doing. So, one of the suggestions I made for that is allowing the system to be powered up so they can menu navigate while they're going through the class. The way I equate that is if I'm going to teach you how to use PowerPoint in a four-hour block of instruction and then in the afternoon you go ahead and try to work PowerPoint not many not remembering well the menu navigation tools are. Any training that we did organically here is basically ad hoc so a commander will come up on the net and say I need some better emphasis on getting my guy trained up or how to do this because as they leave the NET, they don't touch the system again due to one reason or another and a lot of that knowledge and proficiency atrophies. So, I'll take them through and give another class and they'll go like Oh yeah, I remember this, or I remember that while teaching some advance stuff on that part. And I did that in this last 10-day exercise no less than five times with the individuals that were out there just because we had not touched the system since the NET training. And part of that is the commanders not understanding what kind of tool that they have because it's not being relayed from the operators at that squad-level. And some of it could be misconceptions or just preconceived notions with the prior UAS system that we have like the RQ 11 or the RQ20 Puma which was its big it's large it's loud and it has a tendency to lose link if proficiency is not there with the operator. So, as I walked these guys through I kind of coached them on how it can be implemented into that and every time I teach I kind of tailor it to what the unit's mission is. So, if I'm training them on urban operations or open operations based on what they're training up for that's how I'll tailor it to the soldier. The NET was good to get their feet wet, but it's just basically given them a license to operate it when we get really good at is when we actually employ it, and I think there's a gap between what we need to be and where we're coming out of NET. And I understand it's the unit's responsibility, but I think a better way to do it is to maybe add another day onto NET to give them a better opportunity to fly it or the unit at the end of NET does it organically. But I think NET needs to be extended maybe a day or so just to drive a nail home as far as getting some of these operational standpoints down with the operator.

P1: Your unit is actually unique in that you received two iterations of NET through PEO. Is that correct; you did it with the generation one which is the training you just talked to me about but was the fielding of generation 2, or the one for one swap, was that conducted in a similar fashion as the original net training?

A1: The original NET training we kind of rushed because it was a separate brigade that was templated to receive those, but I came up on the net with division with force Mod office and I said hey we're getting ready to go out the door can we divert this fielding from one brigade to our brigade. So, we rushed it; it was no shortage in timeline for the NET. I mean the NET was conducted pretty much the same with the version one versus 2. When we did the second NET earlier this year, we only had one or two guys that had gone through the first net that went through the second NET. We did lose a lot of our operators to ETS or PCS, so we had some of that knowledge atrophy inside the unit. And a lot of that stuff wasn't shared because one guy goes through the training here through the NET in that platoon, he's now tagged as the guy, so he never really had an opportunity to train somebody else on it. So, comparing the two NETs they were fairly similar as far as how they're conducted and what the

outcome was. But I did not notice any real difference between the version one NET and the version two NET.

P2: In the initial you said that you expedited the fielding for your brigade because of the deployment that was coming up, and you also mentioned that there was really no shorting in the execution of the curriculum. Did every student get a chance to conduct the hands-on training?

A2: Every student did do the hands-on training. It was essentially a one-on-one instruction at some point, and it was group instructed at the others. So, what the instructor did is broke them down into groups of 3, 4, or 5 and they just took turns flying it while the other people watched. Where I think the shortfall is, it's kind of the same in both NETs, that in the first NET we got fielded 57 systems but we can only train 30 guys so that was a significant shortage right there on the amount of personnel we could get through the class. So, we had less guys trained, almost 60% of what we got fielded. So, what that forced us either the unit or the platoon didn't have other personnel to train or a platoon down at that level didn't have the trained personnel in it more than likely that system sat in the box for the deployment. And its kind of carried over to the second NET, as well where from version one to version two we traded in 57 but we received 127. So, I think we only had 28 people in the second NET so we essentially more than doubled our system allocation and still only trained about 30% of the personnel. So, it's heavily reliant on the unit to self-train but if the skill sets aren't in the platoons, use like a rifle platoon for instance or rifle company, so first platoon had two trained guys in it and second and third platoon also had systems but no trained guys the commander has to actually set a priority so they can cross train across the formation. But it's only at the expense of the training that they're already doing it at the first platoon. So, what I would suggest as a change for that is if we're doing a large fielding of something of 127 systems, we're doing a swap over from increasing from 57 and 127 based on the issue documents (basis of issue - BOI) is that we run two NETs. I understand that we have a student structure ratio that we have to maintain but the units can be allowed to exceed so if we run two NETs or maybe even three NETs inside a two-week period, we can essentially double or triple the amount of instructor trained personnel and therefore really enable that force multiplying function inside the formation. And even right now we have more systems than we do operators just because of our OPTEMPO. We haven't been able to run something centralized inside the brigade. So, it's more of onesies and twosomes coming up to me to get trained on it because their commander has now deemed it their priority to getting trained.

P3: So just to recap really quick you said that quote unquote follow me function that didn't get either that didn't get taught extensively during the net or it was something that maybe just didn't resonate with the operators?

A3: I think both carry weight on that because the amount of information that's being pushed to them is so much, you're going to remember the highlights you're going to miss some of the details. The only reason that I know about it is stuck in my head is because I took a lot of time and I asked a lot of questions because I knew I was probably going to be the primary trainer for this, so I had a little more one-on-one because I wanted to know what every single thing did on it. So, that's one of the reasons why it stuck in my head and every once in a while, you get one of the guys that go Oh yeah, I remember that because it essentially, it's a manipulation of the system to fly to a moving waypoint essentially. So, there isn't follow me function it's just flying to a moving waypoint I guess would be more accurate.

9. Do you believe the SBS simulator is useful, and, if so, describe how did it improve your understanding?

Response: The only experience I have with the simulator was during the NET for those 15-20 minutes that I used it. One of the barriers to utilizing, I guess first I should say we have two simulators that I maintain. However, the restriction on it since it's an outside program is that I can't hook it up to just any computer; I have to have two stand-alone computers to utilize it. So, I'm looking at an infantry brigade which has 127 system, so you see 127 operators not more. I got two simulators for the entire population, and then it still has to be done and installed on a stand-alone computer because of networking concerns and information awareness. So, we have not employed the simulator since we received it. They're actually still in the cases and haven't been pulled out yet.

10. After you were initially trained on the SBS system, did the unit ever schedule sustainment training on the equipment (i.e., platoon training, sergeant time training, individual Soldier proficiency)?

Response: I haven't heard anything, but I leave a lot of that stuff autonomous; they're not exactly reporting when and if they use it. Just the major brigade exercises to where it requires for brigade airspace coordination in the field. That's mainly when I know when they're using it. I'll send an email out once every once in a while, to say hey are you guys using the stuff and generally I get No's because the opportunity doesn't present itself. And it's not because of the opportunity to train just the opportunity to employ it based on our range regulations. So, a lot of our rifle ranges and our training sites border Rotary wing aviation corridors and based on the Fort Bragg regulations you have to maintain a certain distance off these corridors which essentially prohibits the use of any of the smalls. So, if we take the guys out to 249 range or an M4 range and say they go ahead and fly down range get some use out of it, however that range is only maybe 300 meters long and that 300 meters, the entire range, is inside the corridor. So, I've been trying to convince range operations to kind of ease up on some of the restrictions that they have on that and adapt it. But as far as guys coming up on the net and saying yeah, we used it last week there's no traffic like that inside our brigade. And I think it's because we only really use it during brigade and battalion exercises when you have to precoordinated for airspace clearance I told them there's no problem taking it behind your structures or cops and doing some upper flight at that level but not actually conducting a full-on mission flight because all of Fort Bragg falls underneath controlled airspace either with Simmons army airfield or Pope airfield ran by the Air Force. So, by regulation were prohibited from conducting flights inside that controlled airspace without first having a memorandum agreement with the airfield manager. So, anytime that we fly legally has to be out in the training area which creates a barrier to training because we can't really load up a guy and take them out there because when we let's say we just picked up a random open area to go fly we have to have an RSO and an OIC and both of them have to be an E5 or E6 and above. So, it's not you know taking a squad out and go train it's like that you have to take a platoon out there and then conduct the training that way so it's a larger training event than I think is initially planned to see that this is a squad asset. So, that that is a barrier to proficiency training or currency trading.

P1: So, it sounds like regulations are the biggest thing restrictions right now, correct?
A1: Correct. I'm still pushing that forward and I'm trying to solve this problem, but Fort Bragg the way it's laid out it's not a really good example because we aren't in airspace for the entire post where something like Fort Riley, they actually have a UAV park on post so a guy can just go up your UAV park at will and go fly it without the need for any type of RSO range brief or OIC because it's on their own golf course and they labeled as a recreation UAV park. But we don't have anything like that at this point. I do have a current effort in the works where I'm trying to contract a company to come and build a netting system on Fort Bragg but where my hurdle is right now is finding land to do it. So, if I were to put a number on it from start to 0% in completion it was a use it on post as I'm saying probably about 25%. So, that's my way right now to get around regulation restrictions and the base restrictions.
P2: You've already discussed the type of unit training that you guys have been able to accomplish. You mentioned that in particular in this last field problem it's been like hey you taskings- can you refresh these couple of operators so they can employ it during the training exercise, and you said that recently commanders have deemed it to be an actual priority, so they've been sending you onesies or twosomes, is that how I understand it?
A2: Yeah, that's pretty much it. Depending on the commander's mindset and how they want to employ it, some are a little more motivated than others. Sometimes I kind of reel them in or try to make it as a hey I'm going to provide you a service if you want to send someone instead of them coming up on the net and saying hey, I need help. Because a lot of these smaller systems don't become a priority unless someone makes them a priority or shines light on it because they have so many capabilities sometimes, we forget that they even have it. And I say for instance because the question came up are, we going to fly Ravens during this or do we build airspace for Ravens, and I'm like while you may think about a Raven, but it's a larger kit have you thought about using a Hornet and then it jogged their memory that Oh yeah, we do have a hornet already so then they send a guy or two to get some refresher training.

11. Did you use the SBS during your CTC rotations or field training exercises?

Response: The brigade went out there, but we sequenced by battalion, so each battalion had a three-day window that they executed with. So, the timing was set for four days one is a prep day and then three days for execution.
P1: Were you guys doing battalion or company evals?
A1: It was company evals.
P2: Can you go into a little bit of how you saw the SBS being employed during these company evals? What type of missions?
A2: This is where that one-on-one really kicked in. I gave the guys pointers and the company commanders that were going through I have dealt with in the past, so I gave them pointers. What we did we had open areas, we had personnel in the open, and we had structures as well that we had to breach and clear. What we did with some of them is when they went through their dry or walk rehearsal, they got the 8-digit grids for all the structures that were out there, or all the points of interest and we loaded them in as waypoints in the flight planning mode. So, one of the commanders said hey I want to see building 2 all he had to do was put in the waypoints for building 2 and it flew right to it and so the guy didn't have to navigate based on the FMV to get to where he was to get to that destination. So, it came to fruition when you get a more proficient operator

that he can take a GRG put those grids in the flight planner or a waypoint based off of that. The only other way that they employed it was kind of like an oversight, so they put it up a little bit higher 75 feet 80 feet and we used it to validate that their attack by fires and support by fire positions were in the proper position when they said we were. So, like hey is first platoon set, all they had to do is look over there yep here's first platoon between their support by fire position they are in place. So, it helped reinforce through radio comms with their actually doing.

12. Describe the biggest maintenance problem for the SBS?

Response: I did not get anybody come on the net for broken parts because I wanted to give them extra parts when we did the NET, and they were very forgiving out there as far as if it crashed into something there wasn't a lot of hazards that would cause damage to the aircraft. One of the comments was that their IR bird they're getting decreased usage timeline, so I used as the planning fact about 22 minutes or 21 minutes on the day bird and about 16 to 18 minutes on the IR birds because I'm noticing a trend that those batteries don't last as long. And I'm going to attribute it to the IR camera takes more power. So, that the complaint come back from the guys that you're only really getting 15 minutes of usable flight times out of the bird. So that was one of the concerns as far as the stuff not living up to as advertised because I do believe it says about 25 minutes for battery life on the UAV. But I didn't get anything back as hey we broke that, or this isn't working. We do not have the omni antennas nor the extended cables so they're just running off the RF antennae that's in the hand controller. And it being such a short range, not exceeding about 500 meters, they did not really test the limits of that. But I make sure that they have a lock on location that will make it set back to return home to land.

P1: Going back to that battery issue with the IR, did you find that you have to kind of change the way you plan its usage so that you mitigate the risk of it losing power on your mid-flight?

A1: I'm picking up on that based on what we're using. So, I've used it both day and night, but I don't think we're at the level, most my operators are E4 and below. So, I don't think they're at the level they can forward think. I think it had to be queued by either platoon sergeant, platoon leader, or company commander like hey you know put it up when you think is best or hey how much battery life does it have so, they know at what point you're going to put it up. So what I'm briefing the guys is hey you don't have to stop your movement to put it up when you get close because the aircraft does have the function where you can put it up when you're within 10 minutes of your objective you can put it up set yourself in GCS as the waypoint and then have it fly to waypoint and it will follow you don't have to control anything it will follow you until you want to take control and see something of interest. Which is one of the things that I find that did not get retained from the NET. Either the instructors didn't quite brief it enough or it's something that slipped their mind. So, that's how we're mitigating having to do it in cover or a kilometer away before you get to the objective or they can put it up forget about it and save some of that battery life on the other end and also the objective.

Equipment Documentation (TM, Operating Manual, SOPs)

13. How did the Operator's Manual assist with operations and provide an example?

Response: The only thing I've used the operator's manual for is blasting it out to the companies that want to have a copy of it or that lost it and then the additional authorized list or authorize additional list for the extra components. As far as that manual is concerned, we haven't really used it to instruct because we have been using the NET PowerPoint slides, they provided because it's more of a down and dirty. And then showing them on the help menu of the system itself on the home screen you can actually pull up the functionality of the buttons and characteristics right from the system. I don't think I've ever seen the units reference the manual or ask for; it's just for the commander so that they know what they can order.

P1: What copy of the operating manual do you have?

A1: I want to say the February 2020.

P2: So, you have the dash 10 published by the army?

A2: I don't know where I got it, I somehow accumulated in via unofficial or official channels. When I got it, I made sure I saved it; so, that's why I have that version. As I understand there is a June version that is currently in draft that did not yet get approved; so, I have not yet seen that one. But the one we've been operating off of the February 18 February 2020 is the published date.

P3: Do you also have the previous versions like the manufacturer version from FLIR?

A3: The only version we have and that is that the quick reference guide or the quick book that came with the system so it's like the hip pocket one but it's a once over the world type you know hey this is how you do this that and the other, but it doesn't dive into the details of how stuff works. It's strictly the operational part of the TM but it's a commercialized version of it.

14. What did you most commonly use the manual for? (basic functions, PMCS...)

Response: Because what it is; it's conducting PMCS on it and this is just an assumption based on observations of what I've seen and then when I was a junior enlisted soldier at one time, as well. Like does it have all its parts, does it power on, ok it's good to go. The only time that would really utilize something you know to PMCS is in the trouble troubleshooting mode.

15. At the team, squad, platoon, or company level did you develop any additional SOPs, smart cards, training aid, etc. for the SBS?

Response: I have not seen anything like that if they have generated it didn't make up to my level, but my assumption would be that they didn't even think about doing something like that.

16. Based on the many uses of the SBS have you included it into existing battle drills, TTPs, or SOPs? If yes, please describe.

Response: A lot of this came while we were on deployment so I'm going to try to keep this as unclass as possible. As far as them employing it you got the standard mission set where they're outside of structure, they've launched for handling get eyes on, they're inside of courtyard, anybody in the observation position, or a choke point. But they also pulled it out when investigating possible IED site or a UXO site so instead of having EOD you know spend 20 minutes pulling off Johnny 5 robot out the back of the truck they had the Gunners in the Hatch launch it and then fly to the point take pictures

look at the video and then EOD determined based on that video if it's an actual IED or UXO. So that was one of the things that I thought was a really good idea you need to share this with the next unit because it reduces risk to not only more expensive equipment, but also to our personnel.

17. Have you participated in any currency training as a dedicated SBS operator?

Response: No.

a. Does your unit have a currency requirement (fly every 30, 60, 90-days, etc.)?

b. Do you think the currency requirement helped you with your confidence levels on the use of the SBS?

c. Does your unit have any annual evaluation criteria to maintain your qualification?

d. Can you provide an example of the evaluation or explain how the evaluation was given (i.e., multiply choice test)?

18. Is there anything you would add to the operator's manual or the SOP and what specifically would include?

Response: I don't think so.

SBS Employment

19. What was the nature of your unit's mission (route clearance, armed escort, patrol)?

Response: It was all of the above. What happened with that deployment we were one brigade replacing two brigades? We basically had personnel on the ground, and I want to say in 36 different locations across the country and as everything from base security to route clearance packages to augmenting special forces, holding down a forward operating base or outpost. So, whatever mission that was in Afghanistan we had it just by the nature of where we had our people. Most of our employment of the Hornet was in support of the RCP stuff so as like we previously discussed with the IEDs and our QRF it was used a little less sparsely on the SF side because the SF guys were leery. If the SBS crashed they didn't want to worry about it changing the mission to get a piece of equipment. So, a lot of the RFI I got on it was if this thing goes down do you have to go get it. And I said absolutely not because it carries its own encryption, there's nothing on it that would hurt, and you can still get this thing in almost the same configuration from FLIR commercially. So, that was a lot of concern because based on the dynamic of just that condition it wasn't used as much due to the assets, we already had so there really wasn't a need for them to have that asset at the squad level or team level. In some of the smaller out post they did use it in the guard towers so they're launching from the tower then you know go out a couple 100 meters and then see what those kids are doing out there what's going on out here, so lot of the guard towers got a better vantage point on something that's going on if they have a blind spot whether it's due to trees, due to the terrain, or structure. So, basically increase the visibility of that guard position in those towers; those guys were also limited by the position that was a really windy spot which Afghanistan can be then they didn't get to fly it as much as they would like.

20. Was the SBS included in mission planning, if so, how? (explain what mission planning is if you feel it necessary)

Response: I think it was more make sure we have it type thing talking to some of the operators that was co-located with, sometimes we use it sometimes we didn't, but all that planning occurs above their head so they really couldn't tell me if it was part of the planning process. Talking to some of the leaders that were down it was you know I'm talking about the captains and platoon leaders the way I understood it is it was more about hey let's bring it just in case type thing.

21. What types of missions did you most use the SBS for? (base defense, TCP, route clearance...)

Response: [previously answered]

22. Describe a mission that was successful because of the SBS?

Response: I didn't get a lot of the debriefs that came through. I think where we had most of the success stories that came through like hey this made a difference to the mission was more of the minor detail stuff like for instance with the RCP's or the QRF that are sent out to investigate that UXO or that IED. I think that was probably the only stuff that made it up to me and it's only because like hey we need more of this because we broke something, and I was like oh tell me more about it. So, if they broke something during a mission ask how it happens. It wasn't so much as like trying to assign blame of why stuff broke but hey how are you employing this thing and I tried pull some of that out with those surveys that I did earlier. But I think it's more of that IED or UXO type stuff I think was our biggest success with that. There were a couple times where guys were in contact and they used it but I think it's based on we lost a few of them doing that because when they launched those there was a higher wind condition and they ended up crashing it and never recovered it. So, I don't think there's more of a more troops in contact type employment I think it's more of an investigatory type of employment is where our big successes came from with that and as well as the guys on the perimeter being able to extend their line of sight.

23. Can you think of a time when the SBS hindered a mission? (delayed a mission, stopped a mission, put personnel at risk)

Response: We had a few of them at the start just based on where the airspace procedure guide was generated for theater and then it was more of why we are waiting for this why wait because they needed approval. So, what I did is I worked something out with… it states in the air space procedure guide for that theater that all airspace control measures must be submitted and approved from the airspace control authority and that can take anywhere from 5 minutes up to one hour based on what's going on. So, based on the profile and the size of this UAV, what I did is I just put something together to augment the procedures guide. I say hey we don't need any particular airspace control measure for this. So, basically putting the Raven up we need ROZ. Well, we got G32 to bless off like hey you don't need a ROZ for this just based on what altitude you guys are flying. The only thing that they did hinder a little bit with the employment was anything inside a surface space airspace so like if we come out of Kandahar or Bahgram there was a lot of traffic at low altitude that's where they may have to wait for us but after we enacted change to the procedures guide, we had zero issues as far as the hornet hindering any mission.

P1: Do you think the payload resolution is sufficient to conduct recons of an objective?
A1: I think it's dependent on what you're trying to do with it but for trying to determine the presence or non-presence personnel I think it meets it. If they're trying to identify what type of weapon systems, I don't think it's the right asset for it. If we're trying to determine if is there anybody moving on garbled or anybody on that roof, is there any vehicle traffic that are going around I think it's sufficient. I don't think it's sufficient for trying to get those finite details that we're used to with a larger asset like a Grey Eagle or Reaper. I think choosing the right asset before the mission or the outcome is key for that. And I think there's some misconceptions out there on what this can actually do and then you'll have some disappointment. Like hey we had to get within 50 feet of this guy to determine if he has an AK. And I was like OK I know you're disappointed but you're actually talking about a UAV only weights 6.6 ounces, and it is hovering in the wind. What are you trying to do with it, and I think you employ it in that aspect versus like trying to use it as a Grey Eagle or Reaper when we're expecting to see you know that's an AK or that the PKM or something that's a minute detail point off an FMV? And guys gotten realize that it is squad asset to where it's going to be used to enhance that squad mission gone you know hey is there anybody up it's true point hey is there anybody around that wall so I'm trying to get these guys to think about that when they come back with the resolution sucks on this horrible that this far away. I'm like well use it to determine if there's anybody on the roof you. Let's say you're coming up on a choke point, fly right up there and look around the corner; that's going to give you your indicators whether there's an enemy asset there or not. I tried to be an advocate for it, and I understand some of the limitations, but I basically told them don't launch it when those limitations are going to you know be detrimental to your mission use a different asset for that or try a different vantage point. Once they understood that they kind of stopped with the complaints as far as resolution with it and we understand like oh yeah, this thing is small and I'm not going to get the higher quality picture that I'm used to with another asset.

24. Did you use the system the way you were taught during initial qualification or sustainment training?

Response: No.

25. Think of a time you had to recover a downed SBS. Can you describe the event(s)?

Response: When it went down something was in close proximity to that. So, if it was within 100 meters 200 meters, they recovered it. The ones that were destroyed for instance one of the long over 500 meters they use the distance direction on where it went down and where they lost link with it. I remember they recovered some of the parts with it but not the entire platform. But as far as stuff they're operating, we have at least three- or four more-time incidents of having predatory birds come and take it out of the sky. I didn't believe it at first when I got the 2nd 3rd and 4th report on it and like ok you guys really weren't screwing around this really did happen. I basically left the guidance with the commanders and I pushed it out to other channels that hey it's a small piece of equipment that can be replaced it's not worth it going hunting for it. If we're looking at like a Puma or Raven where white its grey, its rather large you can see that thing from the sky on the ground with no problem with this thing [black hornet] you

will lose it in three blades of grass, you're not going to find it but don't put the guys at risk of injury, don't go get it.
P1: For those close proximity ones you said they used distance and direction, is that something that was taught to them in the NET or how did they go about it?
A1: It's actually displayed on the screen the whole time the distance and direction from where you are and then it gives a reciprocal back azimuth as well as from the UAV. So, there's something that was reinforced when we did that one guys unintentional crashed it so that's when it showed him the LED function so you can see it at night this is a big function for during the daytime. I don't know that it was specifically taught to the individuals during the NET. And it's displayed 100% of the time on the GPS screen.

26. For a future SBS configuration would you prefer:
    a. The existing configuration - Two air vehicles. One air vehicle with Electro-Optical (EO) sensors and one air vehicle with both EO and Thermal Imaging sensors
    b. A single air vehicle configuration - One air vehicle with both Electro-Optical and Thermal Imaging sensors, but capable of providing the same amount of mission coverage (twice as long as the existing air vehicles).
    c. Other configuration (Please describe)

Response: I think if I had to pick another configuration it would still be probably day-night capable only because you can use the IR feature during the daytime for lowlight condition. With that is knowing what I know with this system and how much money I would prefer one larger system with a longer battery life and more stable just based on what I see in theater. If I could double the weight of the bird like if I could get those two versions together and get 13 ounces and as little more battery life more stability in flight with higher wind conditions, I would take that over 2 smaller ones.

27. Is there anything not covered in the interview that you would like to expand on at this time?

Response: I think one of the biggest complaints I had at the initial start was the levels of sustainment that we had when we broke up early we had probably a 67% or 60% OR three months into our deployment with no sustainment plan because I was told by soldier sensor PEO that they were working it but I ended up having to pay with unit funds to get replacement parts plus our losses for the next five months so we ended up dropping almost 1/4 million dollars on parts just so we can finish up our deployment. That was one of the things that really hurt us and as we go forward with this I think when we do any future fielding's which I think is corrected with this one is that I got a lot of replacement parts right off the bat so if we broke an AV or broke a prop, we already had stuff on hand to fix those issues. So, the sustainment thing was a thorn in my side up until this most recent NET. As far as operability I think we've already talked about it may be extended to two classes per NET so we can get more SMEs instruction to the user level. I think it's more feasible to double the NET time and include two more training days. So, we can run the double amount of personnel through it. But I think a lot of it is it got the misconception level it's part one that I think its commanders can better at understand what it can do and have better operators, I think we can solve the lack of usage issue once we get the employment a little more. Exposing the leadership to

it at the junior level will help reinforce the utilization at a future time. It's going to help you need to sleep more not training and I know Fort Lewis or no I'm sorry it was Hawai'i a one of the guys another one you can run this unit he came to Fort Bragg and got the training his responsibilities go back everything funny to train himself has essentially, we're trying to say 127 guys one trainer that was received it. So, I think the major point on anyone's list outcomes of this study comes it is increasing the training capability from the start not going be so much of an issue once it starts during operations or unit had it done for you know 3, 4, or 5 years I think it's one we're standing up feature units whether it's in the National Guard or any other division have it I think that's what we're going do.

Questions Supportive of the Snowball Sampling Method

28. Is there anyone else who comes to mind you would consider as proficient with the SBS system who would be beneficial to talk to?

Response: [Not applicable]

29. Do you have their contact information?

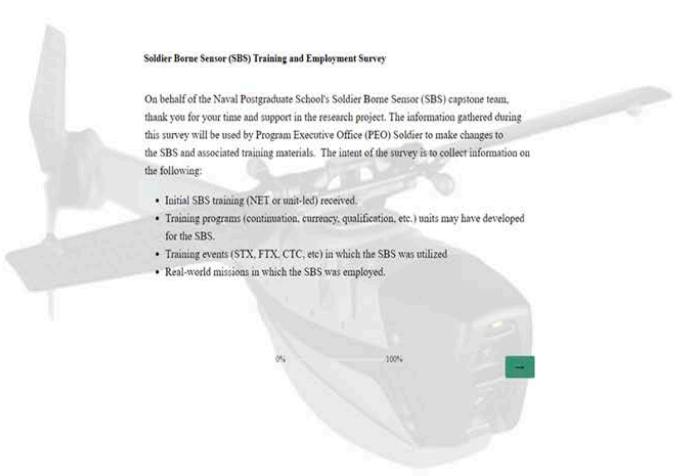
Response: [Not applicable]

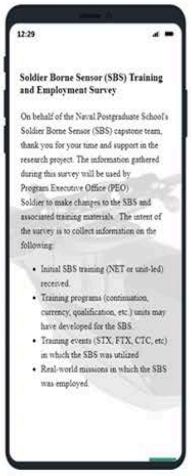
30. Can you ask them if it is ok if we contact them?

Response: [Not applicable]

APPENDIX G. SURVEY QUESTIONS

SBS Training & Employment Survey





Who instructed your SBS system qualification training?

- ○ New Equipment Training (NET) Team (1)
- ○ Unit-Level Training (2)
- ○ I did not receive any formal training (3)
- ○ Other (4) _____

How confident did/do you feel using the SBS system?

	Completely Confident (1)	Confident (2)	Neutral (3)	Unconfident (4)	Completely Unconfident (5)	Does Not Apply to Me (6)
After your qualification training. (1)	○	○	○	○	○	○
Before your first mission in theater. (2)	○	○	○	○	○	○
At present time. (3)	○	○	○	○	○	○

Have you ever used the SBS simulator (laptop with SBS software and USB-hand controller)?

- ○ Yes (1)
- ○ No (2)

Display This Question:

If Have you ever used the SBS simulator (laptop with SBS software and USB-hand controller)? = Yes

How useful was the simulator in improving your understanding of the SBS system?

- ○ Extremely useful (1)
- ○ Moderately useful (2)
- ○ Slightly useful (3)
- ○ Neither useful nor useless (4)
- ○ Slightly useless (5)
- ○ Moderately useless (6)
- ○ Extremely useless (7)

Display This Question:

If Have you ever used the SBS simulator (laptop with SBS software and USB-hand controller)? = Yes

What is the most important thing you have learned using the simulator that transferred into your training or operational employment of the SBS?

_____

Which best describes your role with the SBS system?

- ○ Primary SBS Operator (1)
- ○ Manager/Supervisor of SBS Training (2)
- ○ Manager/Supervisor of SBS Employment (3)

Start of Block: SBS Operator Section

How long has it been since you last used the SBS system either in training or a mission? (if over a year, choose 12 months)

	0 1 2 3 4 5 6 7 8 9 10 11 12
Number of Months since last use. ()	

Select the number of times you have used the SBS system during the following events: (even if you have used the system zero times, you must move the slider bars to "0")

	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Currency training at the unit level ()	
Field Training Exercises ()	
Combat Training Centers (NTC/JRTC/JMRC) ()	
Combat Operations/ Deployment ()	

On what percentage of your total missions or patrols did you use the mission planning tools, such as way points or routes? For example, if you always used the mission planning tools, slide the bar to 100%. Conversely, if you have never used the mission planning tools, slide the bar to 0%.

	0 10 20 30 40 50 60 70 80 90 100
Percentage of missions using mission planning tools ()	

Did the NET team or unit-level training teach you any creative ways to employ the SBS system?

- ○ Yes (1)
- ○ No (2)

Display This Question:

If Did the NET team or unit-level training teach you any creative ways to employ the SBS system? = Yes

What was the creative tactic or task learned?

_____

End of Block: SBS Operator Section

Start of Block: Supervisor / Manager Section

Did your unit develop any of these training aids for the SBS system?
(Select all that apply)

- ☐ Standard Operating Procedure (SOP) (1)
- ☐ Smart-Card (2)
- ☐ Training aid (3)
- ☐ Other (4)
- ☐ None (5)

Display This Question:

If Did your unit develop any of these training aids for the SBS system? (Select all that apply) != None

What was the most useful training aid developed?

_____

Approximately how many missions have you conducted on your most recent deployment? (slide the bar to the estimated number of missions)

	0 15 30 45 60 75 90 105 120 135 150
Estimated number of missions conducted? (1)	

Of the missions you conducted, what is the estimated percentage for the following:

	0 10 20 30 40 50 60 70 80 90 100
Percentage of mission in which you employed the SBS? (%) (1)	
Percentage of missions that would have benefited from employing the SBS? (%) (2)	

Based on how your unit employs the SBS system, what caliber of Soldier should be responsible for operating it? (Please slide the grade scale to rate the Soldier from A to F)

1 (1)
2 (2)
3 (3)
4 (4)
5 (5)

Did you select what Soldiers attended an SBS System Qualification course (either NET or unit-level)?

- Yes (1)
- No (2)

Display This Question:

If Did you select what Soldiers attended an SBS System Qualification course (either NET or unit-level)? = Yes

Given the operational demands of the unit, what caliber of Soldiers did you send to SBS qualification? (Please slide the grade scale to rate the Soldier from A to F)

1 (1)
2 (2)
3 (3)
4 (4)
5 (5)

End of Block: Supervisor / Manager Section

Start of Block: Everybody Questions

Did you or other Soldiers in your unit ever discover any innovative or creative ways to use the SBS system?

- Yes (1)
- No (2)

Display This Question:

If Did you or other Soldiers in your unit ever discover any innovative or creative ways to use the S... = Yes

Please describe your innovative discovery.

_____

Have you or a member of your unit ever had to locate and recover a crashed SBS system?

- ○ Yes (1)
- ○ No (2)

Display This Question:

If Have you or a member of your unit ever had to locate and recover a crashed SBS system? = Yes

Please describe the best manner you or a member of your unit have found to locate and recover the system.

_____

Please describe your biggest challenge with the SBS system?
You might consider the performance, training, maintenance, or conditions for employment of the SBS system.

_____

How did you overcome this challenge?

_____

After deploying with the SBS, what is the most important thing you learned regarding the SBS system?

_____

Please describe how the SBS training can be improved in the future? You might consider training improvements regarding the NET, simulator, unit-level, or field training exercises.

_____

Which configuration of the SBS system would you prefer:

- ○ The existing configuration - Two air vehicles. One air vehicle with Electro-Optical (EO) sensors and one air vehicle with both EO and Thermal Imaging sensors. (1)
- ○ A single air vehicle configuration - One air vehicle with both Electro-Optical and Thermal Imaging sensors, but capable of providing the same amount of mission coverage (twice as long as the existing air vehicles). (2)
- ○ Other configuration (Please describe) (3) _____

End of Block: Everybody Questions

Start of Block: Demographics

What is your MOS? (for example, infantry Soldiers are 11B)

_____

What position were you serving in while using the SBS system? (for example, RTO or rifleman)

_____

What type of platoon / unit were you assigned to while using the SBS?

- ○ Rifle Platoon (1)
- ○ Scout / Recon Platoon (2)
- ○ Route Clearance Platoon (3)
- ○ Firing / Mortar Platoon (4)
- ○ HHC / HHT (5)
- ○ Security Forces Assistance Brigade (SFAB) (6)
- ○ Other (7) _____

What is your current rank?

- ○ PVT - SPC (1)
- ○ CPL, SGT, or SSG (2)
- ○ SFC - CSM (3)
- ○ 2LT - CPT (4)
- ○ MAJ - COL (5)
- ○ WO1 - CW2 (6)
- ○ CW3 - CW5 (7)

How long have you been in the military?

- ○ 1 - 2 years (1)
- ○ 2 - 4 years (2)
- ○ 4 - 8 years (3)
- ○ 9 + years (4)

Have you ever used commercial drones?

- ○ Yes (1)
- ○ No (2)

Do you play flying-related video games?

- ○ Yes (1)
- ○ No (2)

Again, thank you very much for your time. Your feedback will be used to improve future SBS system and training program.

Please feel free to add anything else you think we should know, or you would like to add.

_____

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APPENDIX H. SURVEY DATA

Table 9. Demographics

Short Question Name	MOS	Position	Unit Type	Unit Type Part II	Rank	Time In Service	Drone Experience	Video Game Experience
Question	What is your MOS?	What position were you serving in while using the SBS system?	What type of platoon / unit were you assigned to while using the SBS?	What type of platoon / unit were you assigned to while using the SBS?	What is your current rank?	How long have you been in the military?	Have you ever used commercial drones?	Do you play flying-related video games?
Response	11A	Self Taught (during fielding) then platoon leader during training	Rifle Platoon	[redacted]	2LT - CPT	2 - 4 years	Yes	No
	11B	Platoon Sergeant	Rifle Platoon		SFC - CSM	9 + years	Yes	Yes
	11B	Scout Squad Leader in HAWWWWK Company.	Scout / Recon Platoon		CPL, SGT, or SSG	4 - 8 years	No	Yes
	11B	infantryman	Rifle Platoon		PVT - SPC	2 - 4 years	No	Yes
	CIV Contractor	NA	[redacted]	NA	SFC - CSM	9 + years	Yes	No
	18 series	NA		[redacted]	CW3 - CW5	9 + years	Yes	No
	11A	Commander		75th Ranger Regiment	MAJ - COL	9 + years	Yes	No
	11B	PSG	Scout / Recon Platoon	[redacted]	SFC - CSM	9 + years	Yes	No
	11b	drone operator	Rifle Platoon		CPL, SGT, or SSG	4 - 8 years	Yes	Yes
	11b	fire team leader	Rifle Platoon		PVT - SPC	4 - 8 years	No	Yes
	11b	tech	Scout / Recon Platoon		CPL, SGT, or SSG	4 - 8 years	Yes	Yes
	11B	ums tech	Scout / Recon Platoon		PVT - SPC	2 - 4 years	Yes	No
	11B	Gun Team Leader	Rifle Platoon		CPL, SGT, or SSG	2 - 4 years	No	Yes
	11B	UMS Section leader	Scout / Recon Platoon		CPL, SGT, or SSG	4 - 8 years	Yes	No
	11B	Rifleman	Scout / Recon Platoon		CPL, SGT, or SSG	4 - 8 years	Yes	No
	18A	Ground Force Commander	[redacted]	Special Forces Troop (DA)	MAJ - COL	9 + years	Yes	Yes

Table 10. Duration and Training

Short Question Name	Progress	Duration	Training Method	Training Confidence	Training Confidence Part II	Training Confidence Part III	Used Simulator	Simulator Understanding	Simulator Importance	SBS Role
Question	Progress	Duration (in seconds)	Who instructed your SBS system qualification training?	How confident do you feel using the system based on your SBS qualification training?	How confident do you feel using the system based on your SBS qualification training? - Before your first mission in theater.	How confident do you feel using the system based on your SBS qualification training? - At present time.	Have you ever used the SBS simulator (laptop with SBS software and USB-hand controller)?	How useful was the simulator in improving your understanding of the SBS system?	What is the most important thing you have learned using the simulator that was applicable/useful for your training or operational employment of the SBS?	Which best describes your role with the SBS system?
Response	100	14249	NET	Completely Confident	Confident	Completely Confident	Yes	Slightly useful	Basic operations on the joystick/ what each symbol means on the display	Manager/Supervisor of SBS Training
	100	449	NET	Confident	Confident	Confident	Yes	Extremely useful	The basic operation of the aircraft. It's different than my home built racing drones.	Primary SBS Operator
	100	1272	NET	Confident	[redacted]	Confident	Yes	Extremely useful	The training was much more beneficial with the simulator. The software a let me flight the thing with out worrying about crashing it. It also helped to understand the controls. I wish we had one now.	Manager/Supervisor of SBS Employment
	100	847	NET	Confident	Confident	Confident	Yes	Slightly useful	Basic controls using the hand controller because there are a lot of button and not as intuitive as my gaming controllers.	Primary SBS Operator
	100	314	NET	Completely Confident	[redacted]	Completely Confident	Yes	Moderately useful	Using way points	Manager/Supervisor of SBS Training
	100	573	NET	Neutral	[redacted]	[redacted]	No	Neutral	[redacted]	Manager/Supervisor of SBS Employment
	100	817	NET	Neutral	[redacted]	[redacted]	No	Neutral	[redacted]	Manager/Supervisor of SBS Training
	100	773	I did not receive any formal training	Neutral	[redacted]	[redacted]	No	Neutral	[redacted]	Manager/Supervisor of SBS Employment
	100	208	NET	Neutral	Neutral	Neutral	No	Neutral	[redacted]	Primary SBS Operator
	100	431	Unit-Level Training	Confident	[redacted]	Confident	No	Neutral	[redacted]	Primary SBS Operator
	100	764	NET	Completely Confident	Completely Confident	Completely Confident	Yes	Extremely useful	ability to get repetitions in at any time without admin getting in the way	Primary SBS Operator
	100	730	NET	Completely Confident	Completely Confident	Completely Confident	Yes	Moderately useful	helped with memorizing set up	Primary SBS Operator
	100	479	NET	Confident	Confident	Completely Confident	Yes	Moderately useful	start up procedures, emergency procedures	Primary SBS Operator
	100	840	NET	Confident	Neutral	Confident	Yes	Moderately useful	Familiarization with the controls.	Manager/Supervisor of SBS Training
	100	427	NET	Completely Confident	Completely Confident	Completely Confident	Yes	Extremely useful	Troubleshooting issues in flight	Primary SBS Operator
	41	179	NET	Confident		Confident	No	Neutral	[redacted]	Manager/Supervisor of SBS Employment
	100	522	I did not receive any formal training	Confident	Confident	Confident	No	Neutral	[redacted]	Manager/Supervisor of SBS Employment
	73	793	I did not receive any formal training	Confident	Confident	Neutral	No	Neutral	[redacted]	Manager/Supervisor of SBS Employment

Table 11. Supervisor or Manager

Short Question Name	Training Aids	Training Aid Useful	Number of Mission	% SBS Employed	% Mission Benefited	Zero or Hero	Soldier Selected for Training	Caliber of Soldier
Question	Did your unit develop any of these training aids for the SBS system? (Select all that apply)	What was the most useful training aid developed and why?	Approximately how many missions have you conducted on your most recent deployment? (slide the bar to the estimated number of missions) - Estimated number of missions conducted?	Of the missions you conducted, what is the estimated percentage for the following: - Percentage of mission in which you employed the SBS? (%)	Percentage of missions that would have benefited from employing the SBS? (%)	Based on how your unit employs the SBS system, what caliber of Soldier should be responsible for operating it? (Please slide the grade scale to rate the Soldier from A [5] to F[1])	Did you select what Soldiers attended an SBS System Qualification course (either NET or unit-level)?	Given the operational demands of the unit, what caliber of Soldiers did you send to SBS qualification? (Please slide the grade scale to rate the Soldier from A[5] to F [1])
Response	None		0	1	1	5	Yes	5
	Other	Don't think we made one. But the manual for the thing was helpful and really all my soldiers used.	0	0	0	4	Yes	4
	None		0	0	0	5	No	
	None		0	0	0	3	Yes	4
	Standard Operating Procedure (SOP),Smart-Card	Our unit SOPs become the most useful training aid, because they are developed in real world training scenarios and are refined after we identify critical TTP problems or capability gaps. Once the unit SOP is validated, we are able to rapidly train several different operators and implement the system in real world combat scenarios with great success.	30	100	100	4	Yes	5
	Other	n/a	0	0	0	5	Yes	5
	None		17	0	0	4	Yes	4
	Standard Operating Procedure (SOP)	SOPs were developed after the initial use of the system in 2017 in Tajikistan. The SOPs were codified and rehearsed.	30	2	80	5	Yes	5
	Standard Operating Procedure (SOP)	We were the initial testing Team, we developed SOPs based on employment. This was useful in implementing it for future recon operations.	31	5	10	4	Yes	5

Table 12. Operator

Short Question Name	Last Operation	Operation @ Unit	Operation @ FTX	Operation @ CTC	Operation @ Deployed	Planning Tool	Creative Training	Creative Task
Question	How long has it been since you last used the SBS system either in training or a mission?(if over a year, choose 12 months) - Number of Months since last used.	Select the number of times you have used the SBS system during the following events: (even if you have used the system zero times, you must move the slider bars to "0") - Currency training at the unit levels)	Field Training Exercises	Combat Training Centers (NTC/JRTC/JMRC)	Combat Operations/ Deployment	On what percentage of your total missions or patrols did you use the mission planning tools, such as way points or routes? For example, if you always used the mission planning tools, slide the bar to 100%. Conversely, if you have never used the mission planning tools, slide the bar to 0%. - Percentage of missions using mission planning tools	Did the NET team or unit-level training teach you any creative ways to employ the SBS system?	What was the creative tactic or task learned?
Response	0	6	2	0	2	10	No	
	1	5	1	0	2	20	No	
	0	0	0	0	0	50	No	
	1	5	1	1	1	50	Yes	showing more ways to employ
	1	17	16	3	0	72	Yes	building employment
	1	8	4	0	0	100	No	
	3	8	2	0	2	100	No	
	1	7	7	7	7	100	Yes	To use your instincts to steer

Table 13. All Participants

Short Question Name	Innovative Use	Innovative Manner	Recovery SBS	Recovery Method	Biggest Challenge	Overcome Challenge	Import Lesson	Improve Training	SBS Configuration	SBS Configuration Justification	Alibis
Question	Did you or other Soldiers in your unit ever discover any innovative or creative ways to use the SBS system?	Please describe your innovative discovery.	Have you or a member of your unit ever had to locate and recover a crashed SBS system?	Please describe the best manner you or a member of your unit have found to locate and recover the system.	Please describe your biggest challenge with the SBS system. You might consider the performance, training, maintenance, or conditions for employment of the SBS system.	How did you overcome this challenge?	After deploying with the SBS, what is the most important thing you learned regarding the SBS system?	Please describe how the SBS training can be improved in the future. You might consider training improvements regarding the NET, simulator, unit-level, or field training exercises.	Which configuration of the SBS system would you prefer: - Selected Choice	Which configuration of the SBS system would you prefer: - Other configuration (Please describe) - Text	Please feel free to add anything else you think we should know, or you would like to add.
Response	Yes	Incredible reconnaissance tool reducing risk to the soldier and commander. We were a dismounted platoon attached to a mounted company and used squad recon missions to set up small Objective Rally Points (ORPs) where we would fly the BHJ along routes the mounted company would take to check for trafficability, enemy presence, cover, etc. We also advanced far enough on foot to survey the objective. The drone kept us far away from enemy detection and recorded everything we saw. The playback was incredibly valuable to the commander to inform his decision making. In the defense it is of even more value. It can be deployed without revealing your friendly location and can be used to call for fire. I collocated myself with the mortar tubes during a FOB defense lane and provided early detection with the BHJ, gave accurate grids to the enemy locations, and destroyed them all before they attached us. If you have grids for checkpoints you can input them into the mission planning to maximize flight time as well.	Yes	keep video feed on, let operator be the primary person to track it down since he is the one to have the best guess where its at and use "chirp" that is used to help find it. Crashes occur usually when taking off/landing so finding it is not too difficult. If it were to crash a long ways off, good luck finding it.	Must have spare parts on hand; don't come with normally. Line-of-sight range can be an issue in hilly/mountainous terrain; the external antennas need to be BII or more available to purchase. 2590 battery charging cables, we really need these. DC power plugs are not always a given especially in austere environments. The thermal frankly is terrible. At night the system has extremely reduced capability and I never use it due to the risk of crashing is so high compared to the potential benefit of finding enemy. I don't know how the system would behave with heavy EMI like you can see as a TTP for RUMIL.	Battery: charge with vehicles, using slave cable-DC chargers. Range: get to high ground. Still an issue. Thermal: no work around, simply don't fly at night. Spare parts: had some from FSR but we got lucky.	Pilots are extremely nervous about these kinds of devices. They won't let us fly them at the airbase even though they would be extremely helpful for defense. I want to test how our detection systems pick it up/ how fast. I feel like its small signature would give it a lot of freedom of movement and make it extremely hard to detect if used offensively on established defenses.	The GPS denied mode is fairly difficult to transition to and I personally don't feel that comfortable on it. Some more realistic scenarios for that mode would help commanders see its application. field training exercises are tough to standardize because the flexibility these systems provide is hindered by army bureaucracy specifically range control. They see it as a fully functioning air craft and require the same radio transmissions as a normal helicopter. absolutely unnecessary. Awareness is also key; leaders simply don't know about this tech.	3	Unless the Thermal improves, two color with improved battery life.	Battery life in the cold is an issue and there is a fault when it starts up; sometimes it won't acquire any satellites for GPS and you have to re-insert the helicopter into the bay to restart the process.
	No	[redacted]	No	[redacted]	Fear of higher level leaders from employing the system due to fear of loss.	Ask them why we have the tech if they don't want to use it. Also may have jumped the chain of command to inform the Battalion Commander.	We didn't really use it in combat. We mostly used it for training. The main thing we learned is to maintain line of sight and how far we could push it through thicker walls and an RF cluttered environment.	Increase transmitter/receiver power to push through urban environments.	1	[redacted]	Good over all concept, Army higher ups need to acknowledge the usefulness of these systems and stop being afraid to employ them.
	Yes	We support JRTC alot. I would deploy the system during not missions for ambushes on roads. I would have my scouts out to call when vehicles were moving and could have a systems employed at obstacles. From there I would use it to call for fire without having any soldiers present or in danger. It has been successful, but that is for JRTC missions.	Yes	Crashed in a stupid tree when we returned it home one night. The stupid noise it makes was not loud enough to locate it, but the becon, video, and GPS location was all we needed to find it.	Flying in trees. I will the system would return to a predetermine altitude when you do a return to home function. Most of the crashes happen because soldiers assumed it did that because the feature for fling to way points has a preset altitude.	I tell thon to remember, cover it in training, but soldiers are soldiers.	Battery life is really short and needs to be used with care. For example, we would have it fly to way points at obstacles during high traffic times or when our S-2 thought attacks would happen. It helped to call for fire like I said before, but having only one system with night vision limited our use. I with both systems had night vision. Oh, and fix the field of vision with the night system. It was harder to get over targets because of the camera angles.	No real issues, though the training was well organized. I do wish units were fielded more spare rotors, long range antenna, and one to two simulators.	1	[redacted]	Love the system, needs longer battery time, return to altitude, if you keep it two make both have night, increase the night drone FOV, field with the extra stuff I said.
	No	[redacted]	Yes	It crashed into trees. We left the video feed running. The chirping noise and strobe weren't helpful but we found it using the feed along with the distance and direction programs	air restrictions to use it and the fear of it getting broken.	continuously asking to use the SBS so they finally let us use it. We might not have had the completed all the air controls prior but nothing bad happened.	When its setup for use prior to a mission it gives us a quick peak or recon of a target. Its pretty easy when there aren't a lot of trees around and just pop it up, have a look and bring it home	Make parts easier to get and improve the range so we have more options when to use it.	2	Two airvehicles but make the night camera's scanning ability and quality much better and put that on both	good system, but the battery life, distance, and feed quality needs to be improved so we can use it in more missions
	No	[redacted]	No	[redacted]	Cost and battery life	have not	never deployed with the SBS	More hands on/ flight time	2	[redacted]	[redacted]
	No	[redacted]	Yes	It was never found	It has not prop guards, cost to much money, and it's guaranteed to break at some point. It's battery life is garbage which prevents prolong flight times	You can't	It's small and quiet.	It's good enough	2	[redacted]	[redacted]
	Yes	We refined unit TTPs to drastically reduce risk to force and to help confirm or deny enemy activities.	Yes	We use IR markings.	Battery life is the biggest LIMFAC right now. We need these to be able to fly for 2 hours without battery changes.	We carry multiple batteries, but this is not suitable for every mission.	These are going to become min force mission requirements due to risk reduction capabilities.	I thought our NET training was good.	1	[redacted]	[redacted]
	No	[redacted]	No	[redacted]	none	none	na	na	1	[redacted]	[redacted]
	No	[redacted]	No	[redacted]	integrating timing with the strike force	trusting relationships and confidence with equipment	confidence with equipment.	n/a	2	[redacted]	[redacted]
	Yes	adverse environmental area landings	No	[redacted]	carry ability and durability	vendor built combat carry configuration	knowing/understanding system settings and layout in order to maintain noise and light discipline and encryption	increase night flights and adverse environments	1	[redacted]	[redacted]
	No	[redacted]	Yes	we had general idea of crash area then systemically clearing to recover all peices	maintenance	by follow tech manuals carefully	care spare parts	having more flx would allow more time on the platform	1	[redacted]	[redacted]
	No	[redacted]	No	[redacted]	It takes time to get used to using, must commit a line man to learn how to use	establish intermediate, and recurring training	carrying plenty of spare batteries, waterproof batteries	implement hardware change TTP's	1	[redacted]	[redacted]
	Yes	UGF employment at the squad level.	Yes	Used video feed to terrain associate and locate the downed drone.	SBS System had trouble in high winds.	none	Smaller SBS would be a great asset to the platoon and squad level.	More difficult scenarios and adverse obstacles.	1	[redacted]	[redacted]
	Yes	To use your instincts to steer	Yes	By looking for it	Getting familiar with the controls	Using the controls as much as possible to gain proficiency	Teamwork	More teamwork	2	[redacted]	[redacted]
	No	[redacted]	Yes	Last known location from the camera and GPS. Ours was hit by a truck...it did not survive.	We used the beta version in 2017, and the communication system could have been improved, as well as the replacement parts.	We utilized redundant organic communications systems to communicate with the ground force and to compress and relay images and live video back to the TIC/TOC.	Excellent for recon and saving a ton of walking and possible compromise.	Robust replacement parts kit, video package/compression tech, and improved overall communication (from the beta version in 2017)	1	[redacted]	We only utilized the prototype/beta in 2017, not the actual fielded version. 5th SFG S8 will have more details and feedback on this system.
	No	[redacted]	Yes	It was run over by a truck so it was easy to find	Battery life and maintaining eyes on the target	Swapping batteries but this led to a break in eyes on	The drones are fragile with limited range	[redacted]	1	[redacted]	[redacted]

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APPENDIX I. DATA ANALYSIS

The final code structure was comprised of five functional areas: training, employment, hinders training and employment, documentation, and future configuration. The functional areas were further decomposed into categories, sub-categories, and codes to describe and analyze the collected data. Table 14 depicts the five functional areas and decomposition down to the final codes—as reading from left to right across the table. The red text codes signify the codes used to analyze both interview and survey data, indicating the commonality across the two data collection methods. Furthermore, the codes in the black text were only applied to interview responses.

Table 14. Data Codes by Category

Functional Area	Category	Sub-Category	Codes
Training	Net	Improves	Simulator Use, Repetitions, Night Training, and Additional Airspace Classes
		Sustains	Simulator Integration, Student-to-Techer Ratio, Weather Day, GPS Denied
	Simulator	Issues	Interoperability, Hardware, Allocation by Unit
		Sustains	Utility
	Unit-Level Sustainment Training	-	Unit Examples, Training Effectiveness, SUAS Integration, Creative Solution
	Installation Procedures	-	Training Enablers, Training Inhibitors
Employment	Methods	-	Reconnaissance, Security, Intelligence Collection, Target Acquisitions, Mounted Operations
	Operator Confidence	Lack of Confidence	Soldier Survivability, Inexperience, Equipment Loss
		-	High-Level of Confidence
Hinders Training & Employment	System Limitations	-	Battery Life, Controller Configuration, GPS Accuracy, LoS Mission Range, Payload (Field of View and Resolution), Propeller Durability, Take-off and Landing Procedures, Unable to Share Video, Weather Effects
	Logistics	-	Unclear Support Procedures, Shortage of Repair Parts, Expanded BoI
Documentation	Gaps	-	Standardized Currency, Lack of Map Data
	Recommendations	-	Standardized Unit Training, FMF Procedures, Emergency Procedures, Procedural Training Software, Quick Reference Guide
	-	-	Manual Distribution, SOPs or TTPs, Sustains
Future Configuration	-	-	Change Configuration, Maintain Configuration

A. INTERVIEW DATA

The seven interviews ranged from 40 to 82 minutes, with an average interview time of 58 minutes. All interviews were conducted virtually using Microsoft Teams or telephonically to elicit the information outlined in the baseline interview questions in Appendix E. As previously described, the interviews' data was organized into the five functional areas of training, employment, hinders training and employment, documentation, and future configurations. The proceeding five sub-sections present the interview data by functional area.

1. Training

The training functional area contained four categories. The first category, NET, consisted of two sub-categories, sustains and improves, containing eight codes. The second category, simulator, consisted of two sub-categories, sustain and issues, containing four codes. The third category, unit-level sustainment training, contained four codes. The fourth category, installation procedures, contained two codes.

a. NET

The NET category encompassed responses related to PEO Soldier's formal training course. The first sub-category sustains, contained four codes. The second sub-category improves, contained four codes. Each code depicts the number of interviews describing the code— identified by the blue bar— and the code frequency across all seven interviews – identified by the red bar. The same formatting depicting the number of codes by interview and total codes by frequency is used throughout the interview data analysis section. Figure 6 depicts the codes contained in the NET category. The proceeding paragraphs explain each code, the number of interviewees who described the code, and the total times the code was described across all seven interviews.

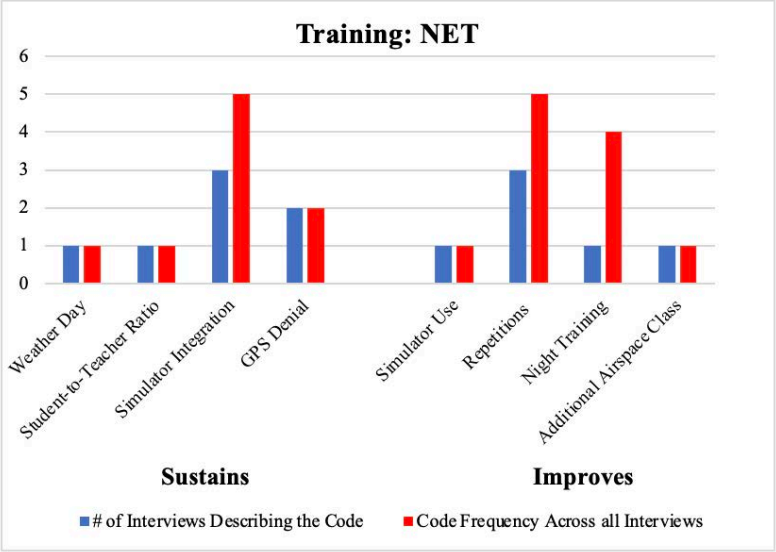

Figure 6. Training: NET Response by Code (Interview)

The interviews elicited positive feedback and sustains for the current NET curriculum, which contained four codes. The four codes were weather day, student-to-teacher ratio, simulator integration, and GPS denial. First, one interviewee (total frequency of one) highlighted the scheduling of a built-in weather day to the course, established a training contingency plan, and increased student throughput. Second, one interviewee (total frequency of one) preferred the student-to-teacher ratio. The established ratio is one dedicated instructor to every four students. The student-to-teacher ratio enhanced student comprehension, specifically during simulation training and controller knowledge. Third, three interviewees (total frequency of five) explained that the simulator's integration was a valuable platform for classroom training that led to a better understanding of controller button-ology and software prior to flying the SBS system. Finally, two interviewees (total frequency of two) described the instruction on GPS denied environments as beneficial and improved their understanding of the system setup and operating procedures within a GPS denied environment.

The interviews elicited NET improvements to enhance the course objectives, which contained four codes. The four codes were simulator use, repetitions, night training, and additional airspace class. First, one interviewee (total frequency of one) identified the importance of increased simulator use during training to become more familiar with the

system's functionality. Second, three interviewees (total frequency of five) emphasized that more repetitions during training would increase operator confidence at the conclusion of the course; therefore, increasing proficiency during follow-on unit training events. Third, one interviewee (total frequency of four) emphasized adding a night training exercise would increase operator confidence when employing the system during night training operations. Fourth, one interviewee (total frequency of one) expounded upon the need for an airspace deconfliction class to improve operator knowledge of the SBS system. The airspace deconfliction code also occurred with the same interviewee during operations with multiple small unmanned aircraft systems (SUAS).

b. Simulator

The simulator category covered responses related to the operator's exposure or lack of simulator use. Figure 7 depicts the simulator's two sub-categories, sustain and issues. The first sub-category, sustain, contained a single code. The second sub-category, issues, contained three codes.

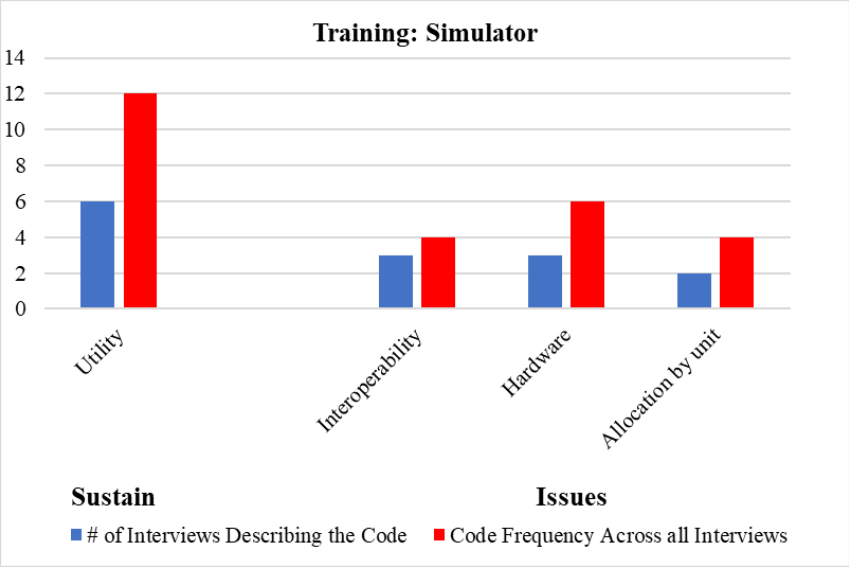

Figure 7. Training: Simulator Response by Code (Interview)

Six interviewees (total frequency of 12) highlighted the SBS simulator's utility and the direct impact the training aid had on increased training readiness. The simulator provided value to unit-level sustainment training for operators to maintain knowledge of the system while simultaneously increasing operators' confidence.

The interviews elicited three codes as issues with the simulator. The three codes are interoperability, hardware, and allocation of the unit. First, three interviewees (total frequency of four) described interoperability issues associated with installing the simulator software from a universal serial bus (USB) drive onto a computer government network, which is not authorized. Second, three interviewees (total frequency of six) discussed their nominal simulator use due to a lack of a dedicated laptop not connected to a government network. The simulator hardware requires a dedicated laptop, which many do not have. Finally, two interviewees (total frequency of four) highlighted the shortage of simulators, allocation by the unit. This code encompassed the lack of available simulator and the impacts on operator sustainment training, which decreased system use during field exercises.

c. Unit-Level Sustainment Training

Unit-level sustainment training described how and what effective ways the SBS was integrated into training and contained four codes. Figure 8 depicts the following four codes: unit examples, training effectiveness, SUAS integration, and creative solutions. First, six interviewees (total frequency of 16) detailed the various ways their respective unit incorporates the SBS system. Multiple responses highlighted the method, planning procedures, and ad-hoc system employment into training events. Second, six interviewees (total frequency of 13) described the SBS's training effectiveness enhancing missions through successful target identification, security, or reconnaissance. Three interviewees (total frequency of four) described integrating the SBS with other SUAS programs—such as the Raven or Puma—increased proficiency or the number of training opportunities. Finally, all seven interviewees (total frequency of 14) described a creative solution involving the SBS during mission planning, conducting operations, or integrating with other training events.

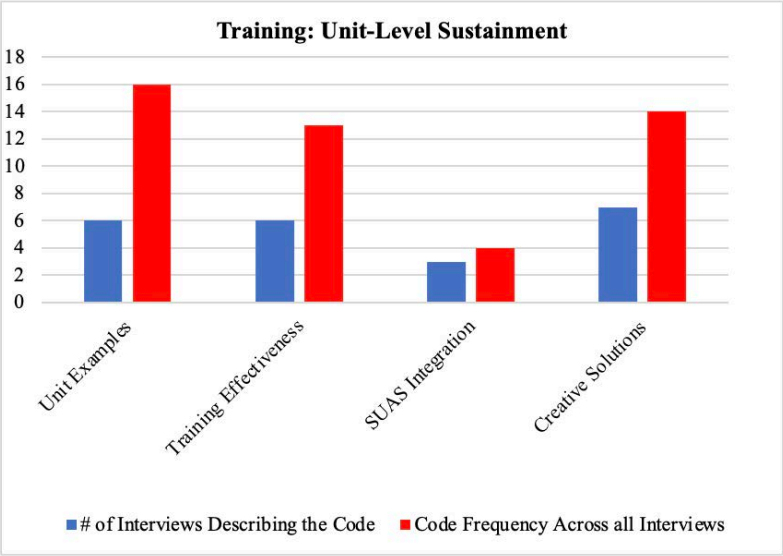

Figure 8. Training: Unit-Level Sustainment Response by Code (Interview)

d. Installation Procedures

Two codes are contained under the installation procedures category, which describes how an installation's regulation either enhanced or hindered SBS employment. Figure 9 depicts the two codes, training enablers, and training inhibitors. First, three interviewees (total frequency of three) described their ability to employ the SBS with limited restrictions or interference from range regulations, which increased system employment and training. Second, four interviewees (total frequency of seven) outlined how installation range control procedures limited or hindered SBS training or employment.

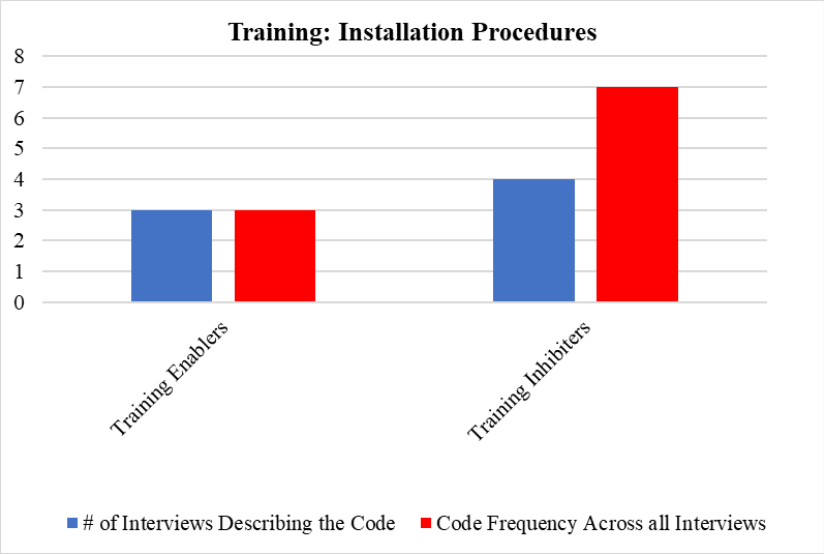

Figure 9. Training: Installation Procedures Response by Code (Interview)

2. Employment

The second functional area was employment. The functional area captures how the SBS system was employed and how operators' confidence impacts employment. Employment was divided into two categories, methods and operator confidence. The first category, methods, contained five codes. Operator confidence was the second category with one stand-alone code and a sub-category.

a. Methods

The interviews elicited numerous methods of system employment, which contain five codes. Figure 10 depicts the five codes: reconnaissance, security, intelligence collection, target acquisition, and mounted operations. First, six interviewees (total frequency of 18) described how the SBS was employed during reconnaissance missions that increased personnel's positive identification, suspicious activity, and enemy vehicles. Second, four interviewees (total frequency of 10) explained how the SBS was employed for security operations that gave an early warning on enemy movement and protected friendly forces. Third, three interviewees (total frequency of 6) utilized the SBS for intelligence collection that enhanced mission success by confirming named areas of interest or providing a multi-asset collection plan. Fourth, three interviewees (total frequency of

six) expounded on target acquisition as a method of employment. The target acquisition code incorporated target identification and adjustments to direct and indirect fires to maximize the enemy's effects. Finally, two interviewees (total frequency of three) described how operators employed the SBS during mounted operations to increase situational awareness.

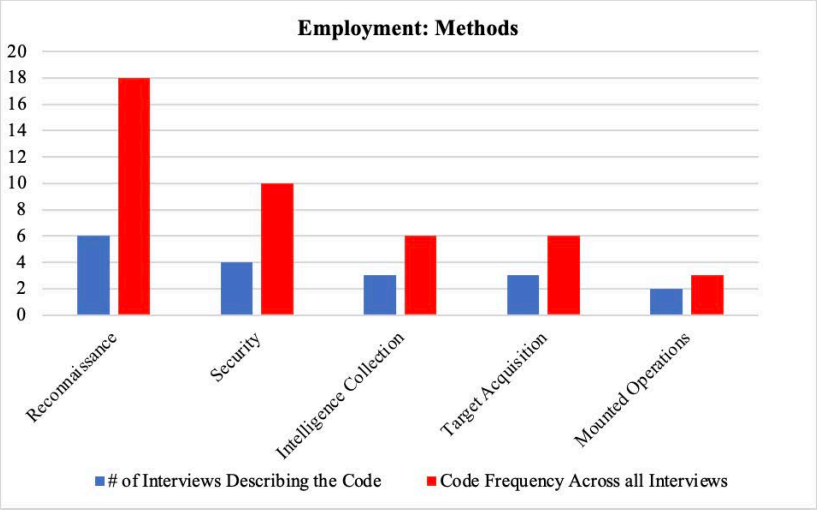

Figure 10. Employment: Methods Response by Code (Interview)

b. Operator Confidence

The operator confidence category described the positive and negative impacts of operator confidence on SBS system employment and is depicted in Figure11. The category contained one stand-alone code and one sub-category. The stand-alone code was titled a high-level of confidence. A high-level of confidence was described by five interviewees (total frequency of 14), and the interviewees demonstrated proficiency and knowledge in the system's limitations and operating procedures. Conversely, the sub-category was titled a lack of confidence, which contained three codes. First, soldier survivability captured responses from three interviewees (total frequency of three) who described situations where the launch, landing, or downed air vehicle recovery placed the operator in greater danger; thus, the situation decreased soldier survivability. Secondly, inexperience was described by four interviewees (total frequency of 11) who described how Soldiers

inexperience limited the use of the SBS system. Lastly, four interviewees (total frequency of six) described situations in which the SBS employment was limited due to the fear of lost or damaged equipment, which decreased confidence and limited SBS employment.

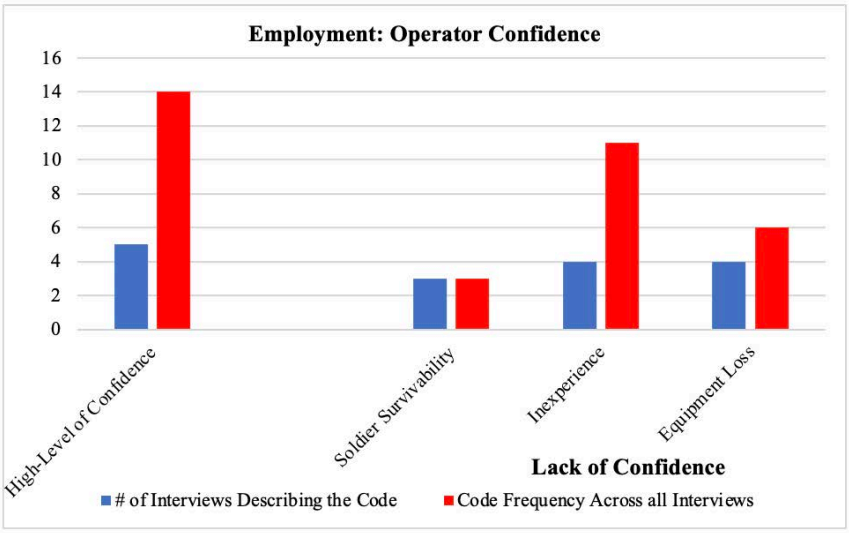

Figure 11. Employment: Operator Confidence Response by Code (Interview)

3. Hinders Training and Employment

The hinders training and employment functional area consisted of two categories. The first category, system limitations, contained nine codes. The second category, logistics, contained three codes. The functional area was developed during the qualitative data analysis process because the codes impact both the SBS system's training and employment.

a. System Limitations

The SBS system's limitations hindered training or employment contained nine codes to analyze interviewees' responses. All nine of the codes contained in the system limitations described instances where SBS operators either did not employ the SBS or the system hindered their mission objectives due to the system's technical limitations. The system limitations hindered either training or operational employment. Table 15 explains the nine systems limitation codes and provides a general explanation of how each code hindered SBS training and employment.

Table 15. System Limitation Codes

Code	Explanation	Impact on Training and Employment
Weather Effects	Impacts of Wind, clouds, or other weather events.	Restrict SBS use or degrade performance.
Payload (FoV & Resolution)	Primary video sensor's field of view (FoV) and the quality of the video resolution.	increases maneuvering of the air vehicle and decreases the distance between the air vehicle and the target or objective.
Battery Life	The length of time the battery is able to power the air vehicle.	Reduces on-station mission time of the SBS.
Propeller Durability	The inability of the propeller's to withstand damage.	Hard landings or object strikes reduce the overall system availability.
LoS Mission Range	The distance the air vehicle can travel and maintain line of sight (LoS) link with the GCS.	As the mission range decreases due to terrain and environmental factors, the SBS operators must be closer to their target.
Unable to Share Video Feed	The SBS is currently not capable of digitally sharing video feed with other systems or platforms.	Situational awareness is primarily limited to the SBS operator.
Take-off and Landing Procedures	The steps required and the manner in which the SBS takes-off and lands.	The longer the time to launch and recover the SBS, the longer the operator is removed from the operation. Additionally, the manner in which the air vehicle takes off and lands requires additional time and considerations to avoid damage.
GPS Accuracy	The precision of the GPS device on the air vehicle and camera marker in reference to the actual point on the Earth's surface.	The inaccuracy of the GPS is not precise enough to call in close air support or indirect fires.
Controller Configuration	The layouts of the SBS's hand controller and intuitiveness of the buttons to accomplish the desired functions.	The usability and intuitiveness of the system increase time to learn and use the system.

Figure 12 depicts the nine system limitations codes which users described as hindrances to training or employment. The most prominent system's limitations that hindered training and employment were the payload, weather effects, battery life, propeller durability, and the line of sight (LoS) mission range. In all seven interviews (total frequency of 12), the subjects described how the SBS's payload hindered either training or employment. Of the twelve times the payload was discussed, seven referenced insufficient video feed or resolution, and five referred to the limited field of view (FoV). Additionally,

five interviewees each described the weather effects (total frequency of 12), battery (total frequency of 9), propeller durability (total frequency of 5), and LoS mission range (total frequency of 7).

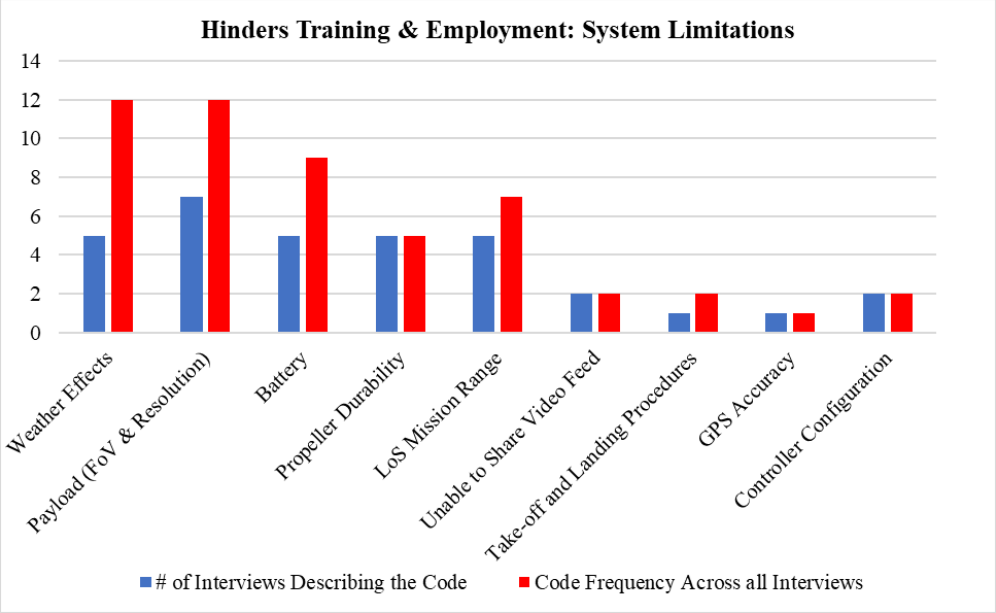

Figure 12. Hinders Training and Employment: System Limitation Responses by Code (Interview)

b. Logistics

The logistics category contained three codes, which described how sustainment issues hindered the SBS system's training and employment. First, unclear support procedures were illuminated by four interviewees (total frequency of seven), which indicated interviewees did not clearly understand the procedures for the requisition of new and replacement parts. Their lack of understanding of the logistics procedures resulted in underutilization of the system by not understanding how to request spare or replacement parts or how those parts were funded. Closely related was the shortage of repair parts, the second code. The shortage of repair parts was described by four interviewees (total frequency of five). However, the shortage of repair parts code illustrates the inability to train or employ the system because of a physical lack of on-hand replacement parts. Lastly, six interviewees (total frequency of 12) described or requested an expanded basis of issues

(BoI) for the SBS systems. The expanded BoI code indicates users' desire for the system to include additional components. The existing BoI does not include all of the components needed by end users, which limits their training or employment methods. The unclear support procedures, shortage of repair parts, and expanded BoI codes are depicted in Figure 13.

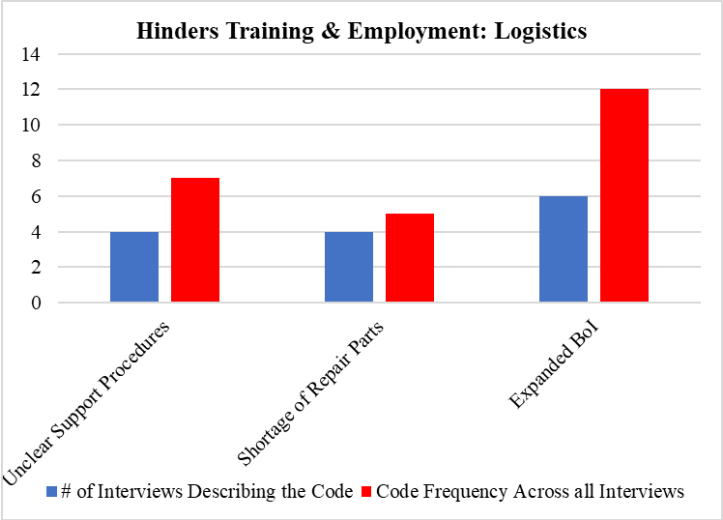

Figure 13. Hinders Training and Employment: Logistics Responses by Code (Interview)

4. Documentation

The documentation functional area contained three stand-alone codes and two categories. The three stand-alone codes are: sustains; standard operating procedures (SOPs) or tactics, techniques, and procedures (TTP); and manual distribution. The first category is recommendations, which contained five codes. The second category is gaps, which contained two codes.

The sustain code within the documentation functional area was described in four interviews (total frequency of seven) and captured positive feedback about the existing operator's manual and training material. The SOP or TTP code captured examples of how two individuals (total frequency of four) formalized the SBS into their units' procedures and tactics to employ the system. Under manual distribution, two interviews (total

frequency of two) described the need for the publication and distribution of the Army's approved technical manual. Figure 14 depicts the three stand-alone codes and the recommendations and gaps categories—described in the proceeding sub-sections.

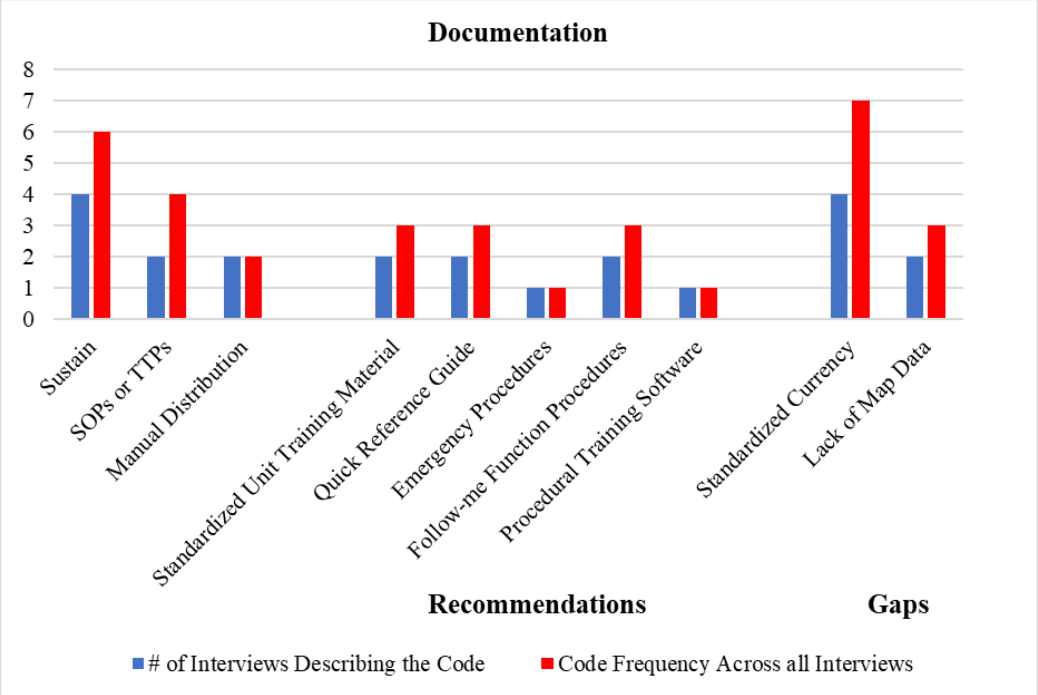

Figure 14. Documentation Response by Code (Interview)

a. Documentation Recommendations

The interviews elicited general recommendations or improvement areas for the SBS system's existing documentation, which contained five codes. The five codes are standardized unit training material, quick reference guide (QRG), follow-me function procedures, emergency procedures, and procedural training software. First, two interviewees (total frequency of three) alluded to a need for standardized training material to better facilitate a standardized, unit-level qualification program, which would closely represent a formalized train-the-trainer method of instruction. Second, two interviewees (total frequency of three) described a more encompassing quick reference guide included with the system to make critical procedures readily available for SBS operators. Closely related is the third code of emergency procedures. One interviewee (total frequency of one)

specifically described a need for readily available procedures to aid in an in-flight emergency. The fourth code, follow-me function procedures, was described by two interviewees (total frequency of three). There is currently a workaround for the air vehicle to follow the operator and ground control station; however, there are no formalized procedures outlined in the manuals. Lastly, procedural training software was described by one interviewee (total frequency of one) to improve operators understanding of start-up, shutdown, and GPS denied mode procedures.

b. Documentation Gaps

The interviews identified information gaps in the existing SBS documentation. Furthermore, the documentation gaps category contained two codes. Still referencing Figure 12, four interviewees (total frequency of seven) described SBS operator currency training to maintain proficiency to effectively employ the system; However, inconsistencies and lack of definitive guidance exist among different units on the formalized currency requirements. Secondly, two interviewees (total frequency of three) identified issues regarding updating map data to display map overlays, as described in FLIR's operator's manual. Both operators preferred the ability to overlay current map data but were unsuccessful in updating the data files.

5. Future Configuration

The future configuration functional area directly supported PEO Soldier data to shape the future configuration of the SBS. Two codes support either maintaining the existing configuration of two air vehicles in the system or changing the configuration. Figure 15 depicts the results of PEO Soldier's specified question. Six of seven interviewees (total frequency of six) preferred the current configuration of two-air vehicles. One interviewee (total frequency of one) preferred a change to the configuration to have three air vehicles—two electro-optical (EO) air vehicles and one infrared (IR) air vehicle.

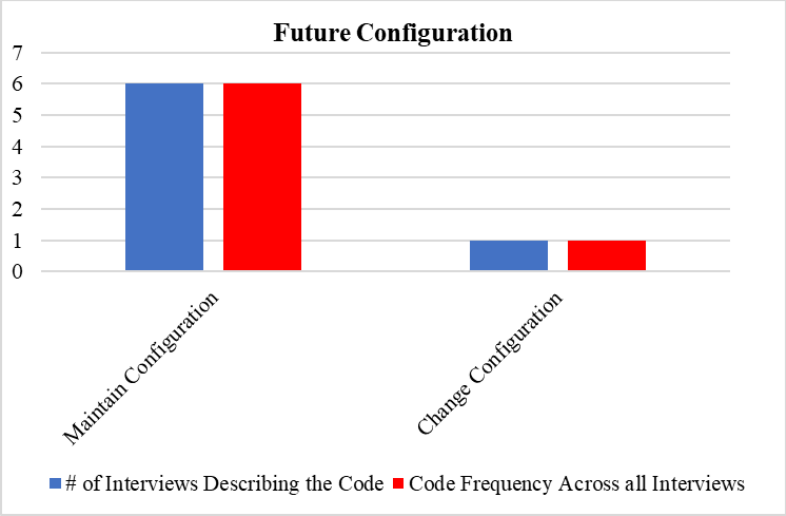

Figure 15. Future Configuration Response by Code (Interview)

B. SURVEY DATA

A total of 18 surveys were collected using the Qualtrics Survey Software outlined in Chapter III. Appendix F contains the complete list of survey questions. The average completion time of the surveys was 23 minutes and the average completion percentage of the surveys was 95%. Of the survey respondents, eight described their role with the SBS system as a primary system operator and 10 described their role as a manager or supervisor.

1. Training

The surveys provided both quantitative and qualitative data. All survey data is presented in the same structure as the interview section above. Additionally, the qualitative analysis code structure was developed using both survey and interview data; therefore, the organized survey data still aligned with the functional areas, categories, sub-categories, and codes as described in the interview data.

a. NET

14 of the 18 respondents were trained by PEO Soldier's NET instructors. Of the remaining four respondents, one received initial qualification at unit-level and three did not receive any formal training on the system. Of the 14 respondents who completed the NET, five indicated they were completely confident operating the system at the completion of

the NET course. Six indicated they were confident and three indicated they were neutral at the completion of the NET course. Zero respondents indicated they felt unconfident or completely unconfident at the completion of the NET course. Figure 16 depicts the respondents' confidence level operating the system after completing the NET course.

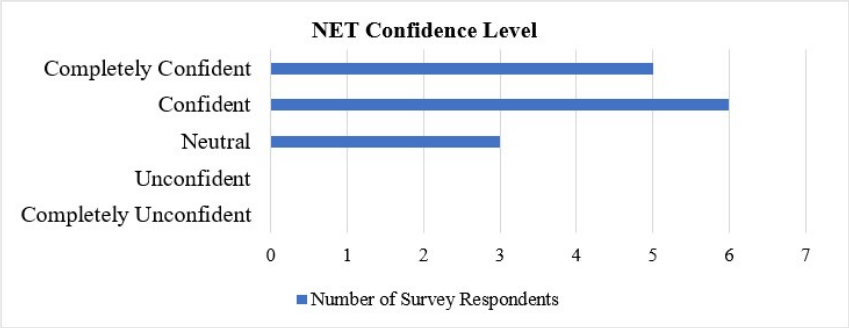

Figure 16. NET Confidence Level

In the NET category, all respondents' qualitative data was sorted into one sub-category, improves, that contained two codes. First, three respondents (total frequency of three) provided feedback that the NET course should increase the number of flight repetitions. Second, one respondent (total frequency of one) indicated a need for the NET course to include training during night conditions. Figure 17 depicts the respondent's feedback regarding the NET course by the number of survey respondents who described the code and the total times the code was described across all surveys.

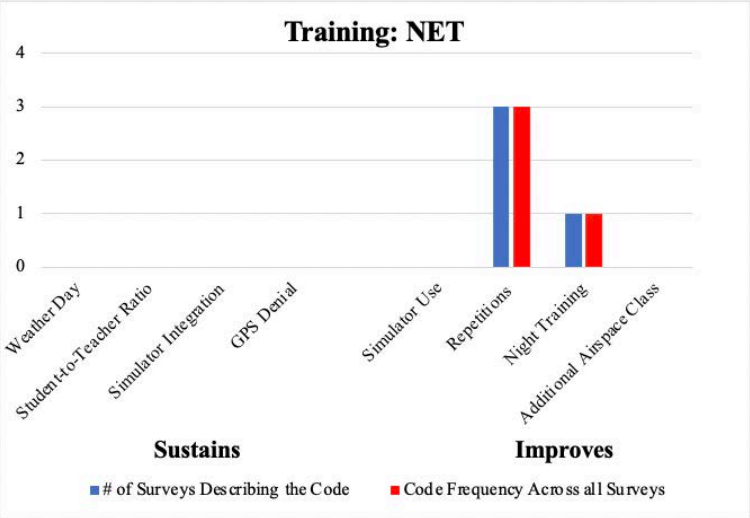

Figure 17. Training: NET Response by Code (Survey)

b. Simulator

10 of 18 respondents used the SBS simulator. All 10 of respondents who used the simulator attended the NET training. Of the eight respondents who did not use the simulator, four attended the NET training. Respondents who indicated they used the simulator, were asked to evaluate the usefulness of the simulator on improving their understanding of the SBS system. Figure 18 depicts the level of usefulness from respondents who have used the simulator. Of the 10 respondents who have used the simulator, four respondents indicated that the simulator was extremely useful in understanding the SBS system. Four respondents indicated that the simulator was moderately useful. Two respondents indicated that the simulator was slightly useful. Zero respondents selected a neutral or negative utility of the simulator in improving their understanding of the SBS system.

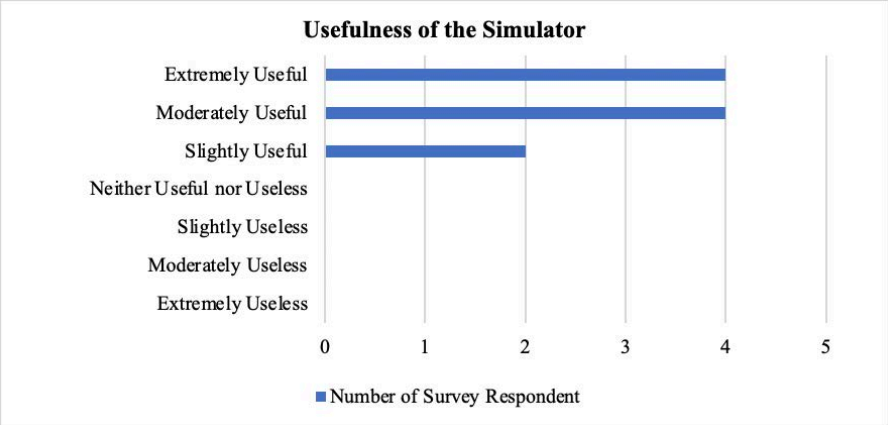

Figure 18. The usefulness of the Simulator

In the simulator category, the survey respondents' answers aligned with both sub-categories, sustain and improves. The sustain sub-category contained one code, utility. Ten respondents (total frequency of 10) provided positive feedback about the simulator's utility in understanding the basic operation and training on the SBS system. Only one code was used in the sustains sub-category. The code described by one respondent (total frequency of one) was the allocation by unit, which describes a shortage of simulators at the unit to conduct training. Figure 19 depicts the survey respondent's feedback about the simulator.

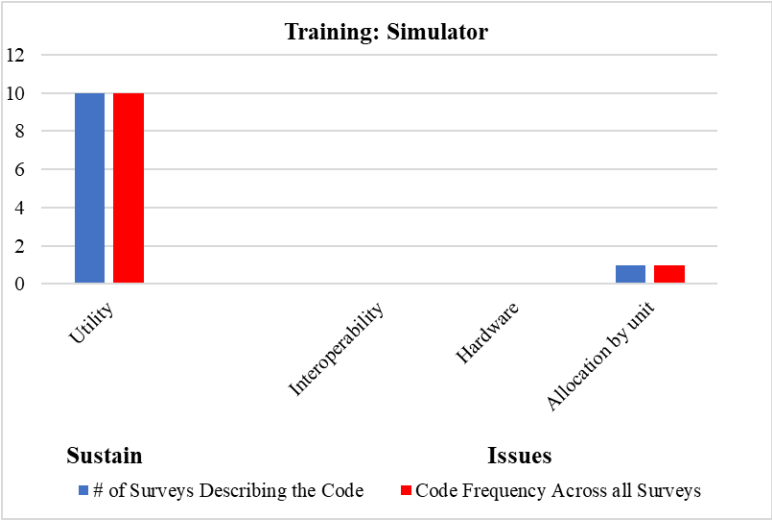

Figure 19. Training: Simulator Response by Code (Survey)

c. Unit-Level Sustainment Training

From the survey data, three of the four unit-level sustainment training codes were described by respondents. First, two respondents (total frequency of two) detailed the various ways their respective unit incorporates the SBS system. Two operators provided examples of unit training. Second, six respondents (total frequency of six) described the SBS's training effectiveness enhancing missions through successful target identification, security, or reconnaissance. Lastly, two respondents (total frequency of two) described a creative solution involving the SBS during mission planning, conducting operations, or integrating with other training events. Both creative solutions were recorded from managers or supervisors who attended the NET. The SUAS integration code was not described by respondents. Figure 20 depicts the surveys which described the codes in the unit-level sustainment category.

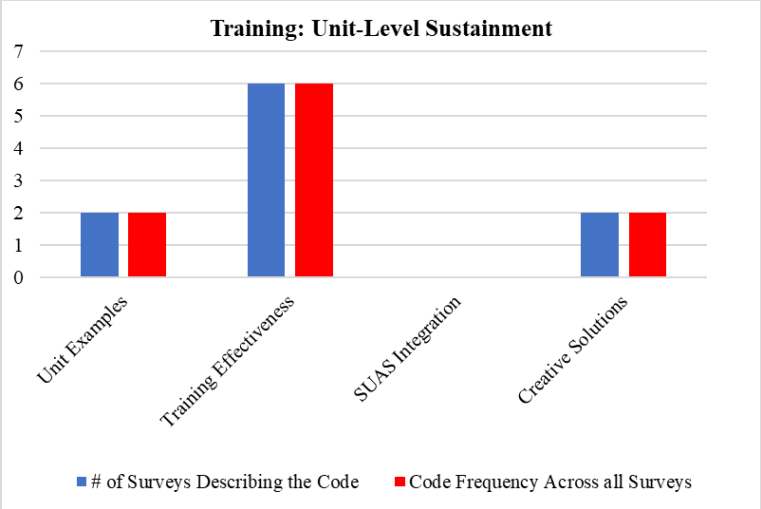

Figure 20. Training: Unit-Level Sustainment Response by Code (Survey)

d. Installation Procedures

No survey respondents provided any data supportive of how installation procedures enabled training. Conversely, three respondents (total frequency of four) described how installation procedures hindered or inhibited training. All responses under this code originated from SBS managers or supervisors who completed the NET course. Figure 21

depicts the number of survey respondents and the total frequency of the code exemplifying how installation range control procedures limited or hindered SBS training or employment.

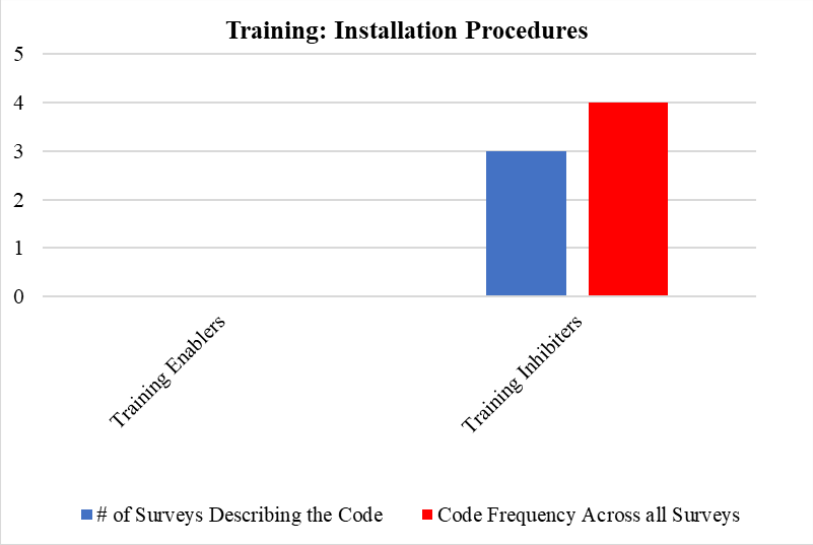

Figure 21. Training: Installation Procedures Responses by Code (Survey)

2. Employment

Survey respondents were asked to choose their level of confidence in the SBS system before employment in an operational environment. Of the 11 responses, three selected completely confident, six selected confident, and two selected neutral based on their training leading up to deployment. Figure 22 depicts the respondent's confidence level.

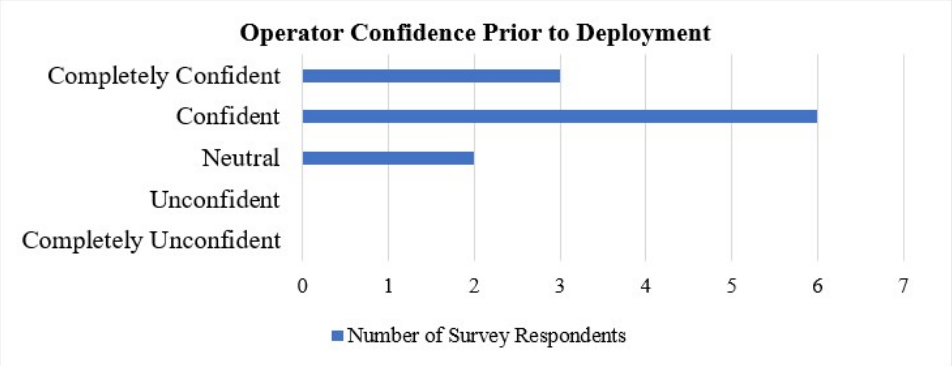

Figure 22. Operator Confidence Before Deployment

a. Operators

The eight operators were asked to recall the last time they had used the SBS system. The eight operators were asked how long it had been since they last used the SBS system. The average response was one month. Additionally, the eight operators were asked to list the number of times the SBS system was used during a training event or an operational mission. Figure 23 shows the average number of times the SBS system was used and by type of event.

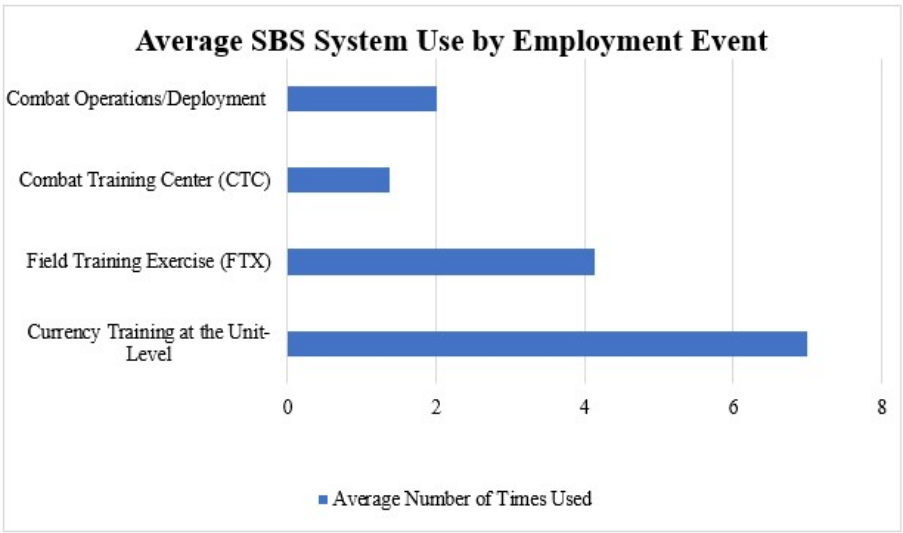

Figure 23. Average SBS System Use by Employment Event

b. Supervisor Manager

The nine supervisor or manager respondents were asked a series of questions regarding training aids, mission employment, and SBS operator selection. The respondents were asked if their unit had developed a SOP, a smart-card, or a training aid for the SBS system. Three of the nine supervisor or manager respondents were in units with an SBS SOP, all of whom are in Special Operation Units. Additionally, one of the three respondents developed an SBS smart card.

The supervisor or manager respondents were asked to recall the approximate number of missions conducted during their deployment. Only four respondents deployed with the SBS system. On average, the four respondents employed the SBS system on 27% of their combat missions. However, the estimated percentage of SBS employment from the four respondents who deployed with the system ranged from 0 -100%.

c. Methods

The survey respondents described SBS employment methods that aligned with three of the five codes. Two respondents (total frequency of two) expressed using the SBS system to conduct reconnaissance. One respondent (total frequency of one) provided an example of using the SBS system to conduct a security mission. One respondent (total frequency of two) provided examples of the SBS system being used for target acquisition. Zero respondents described employing the SBS system for intelligence collection or supporting mounted operations. Figure 24 depicts how respondents described employing the SBS system.

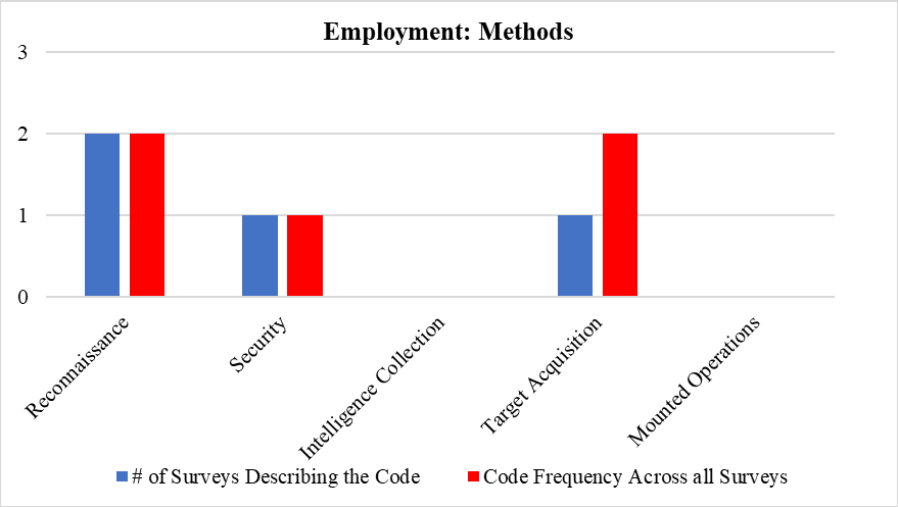

Figure 24. Employment: Methods Response by Code (Survey)

d. Operator Confidence

Survey responses aligned with the one stand-alone code and one sub-category that described operator confidence. Six respondents (total frequency of six) expressed a high-level of confidence in the SBS system—the stand-alone code. Conversely, the sub-category, lack of confidence, contained two of the three codes. Four respondents (total frequency of four) expressed a lack of confidence due to their inexperience with the SBS system. Six respondents (total frequency of seven) expressed concern in using the SBS system from a lack of confidence in fear of damaging the system. Figure 25 depicts the respondents' answers and which code they represent.

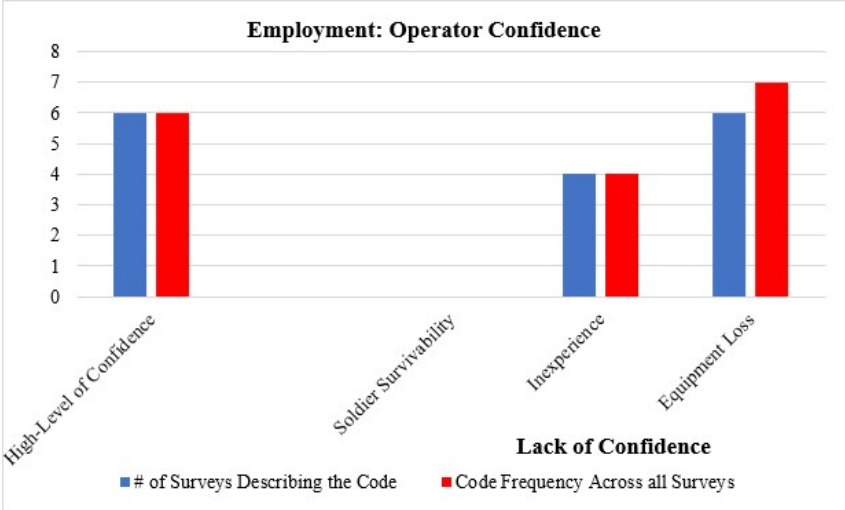

Figure 25. Employment: Operator Confidence Response by Code (Survey)

3. Hinders Training and Employment

By allowing open-ended text responses in the survey, respondents were able to describe any challenges, issues, or recommendations for the SBS system. Similar to the interview data, surveys responses were analyzed using the standardized code structure. The majority of responses fell within the following two sub-categories, system limitations and logistics.

a. System Limitations

The SBS system's limitations hindered training or employment contained eight of the nine codes in the survey data. Figure 24 depicts the alignment of 29 code references categorized as a system limitation. Two respondents (total frequency of two) provided examples of the SBS being affected by adverse weather conditions. Four respondents (total frequency of eight) stated the SBS camera (payload) requiring improvement. Seven respondents (total frequency of nine) expressed that the battery life was insufficient. Two respondents (total frequency of two) mention the durability of the propellers as a system limitation. Five respondents (total frequency of five) alluded that the current line-of-sight range hinders training and employment. The SBS's video feed, take-off, landing procedures, and GPS accuracy were each identified by one respondent (total frequency of

one) as a system limitation. Survey respondents did not describe any system limitation related to the controller configuration. Figure 26 depicts the respondents' answers and which code they represent.

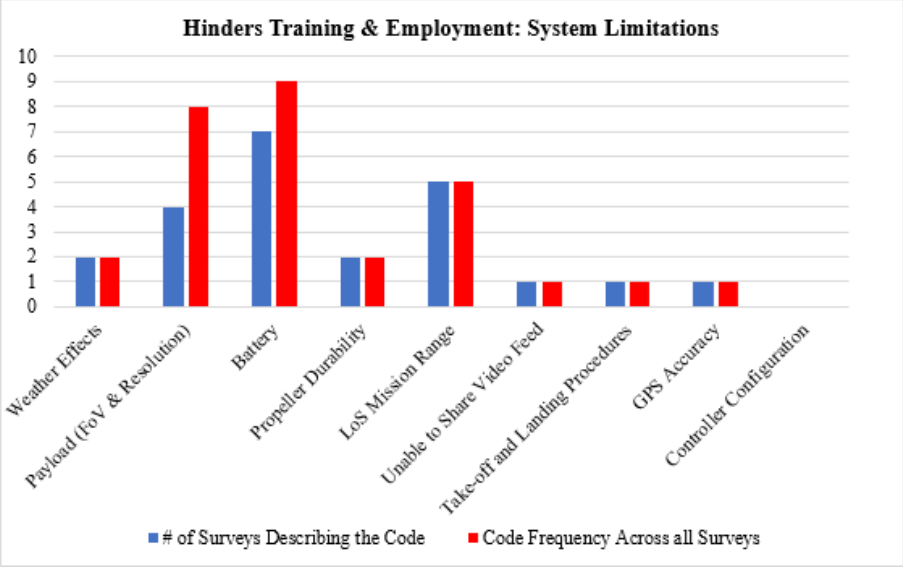

Figure 26. Hinders Training & Employment: System Limitations Response by Code (Survey)

b. Logistics

The logistics category contained three codes, which described how sustainment issues hindered the SBS system's training and employment. First, one respondent (total frequency of two) referenced a lack of understand for support procedures of the SBS system. Second, four respondents (total frequency of five) described a lack of spare parts for the SBS system. Lastly, three respondents (total frequency of six) expressed a necessity to include additional components in the SBS system's BoI. Figure 27 depicts the responses and which code they represent.

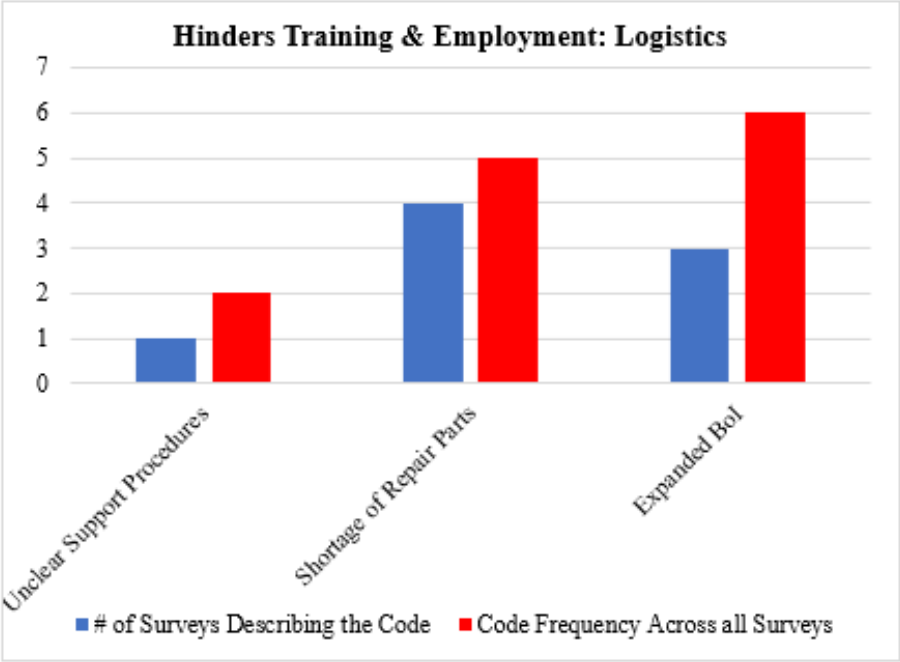

Figure 27. Hinders Training & Employment: Logistics Responses by Code (Survey)

4. Documentation

In the documentation functional area, coded responses aligned with two of the three stand-alone codes and only one sub-category. Two respondents (total frequency of two) expressed that the current SBS manual was helpful in the operation of the system. Four respondents (total frequency of four) described that their units had either developed an SOP or had integrated the SBS into current TTPs. Two respondents (total frequency of two) identified a need to improve the quick reference guide. Figure 28 depicts the surveys responses coded and contained within the documentation functional area.

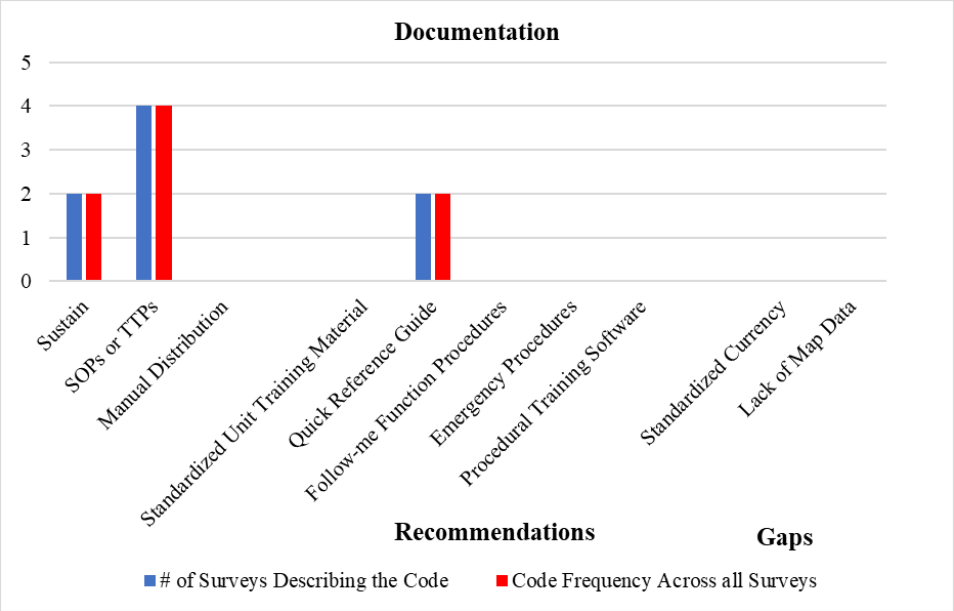

Figure 28. Documentation Responses by Code (Survey)

5. Future Configuration

The survey respondents were also asked about their preference about the configuration of the SBS system to shape the future system's configuration. Of the 16 respondents who answered the question, 10 respondents preferred a single air vehicle configuration, four respondents preferred the current two air vehicle configuration, and one respondent preferred a three-air vehicle configuration. Figure 29 depicts the respondent's preferences on the number of air vehicles in the next generation SBS system.

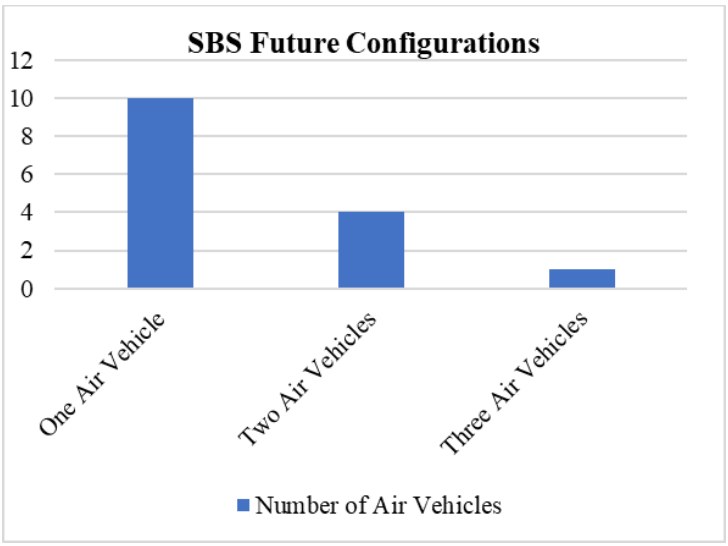

Figure 29. SBS Future Configuration (Survey)

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